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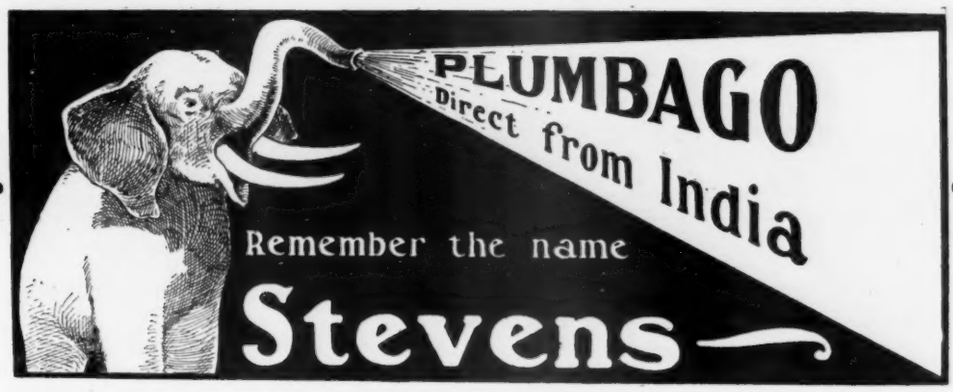

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See page 111

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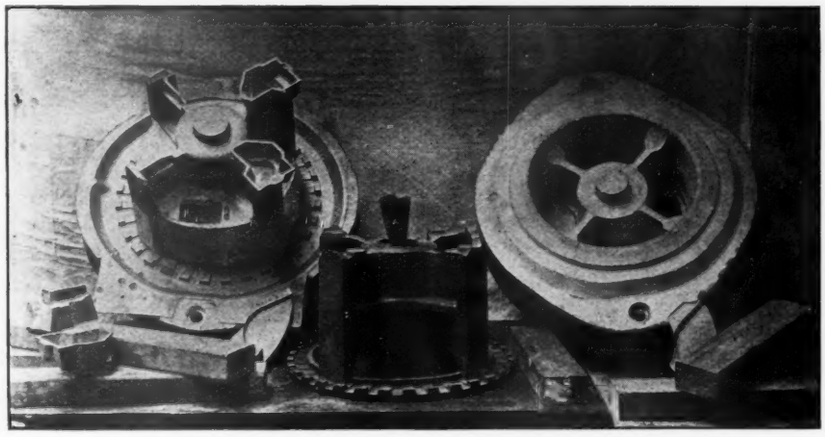

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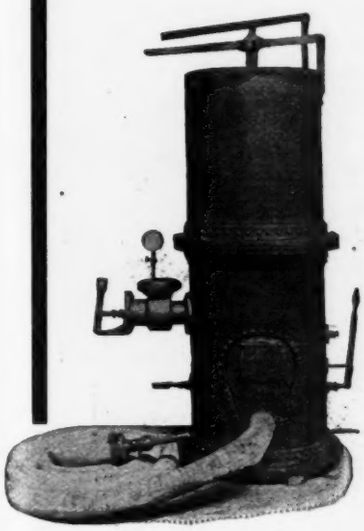

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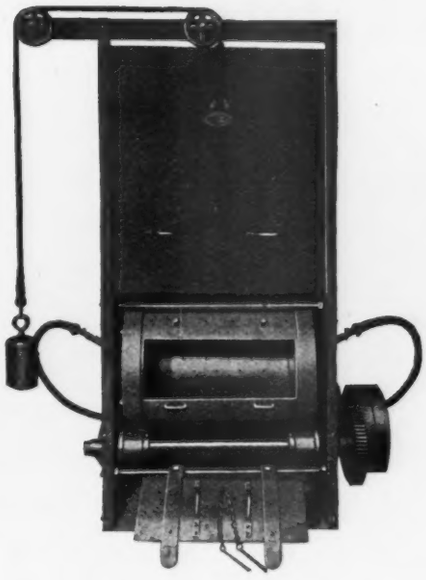

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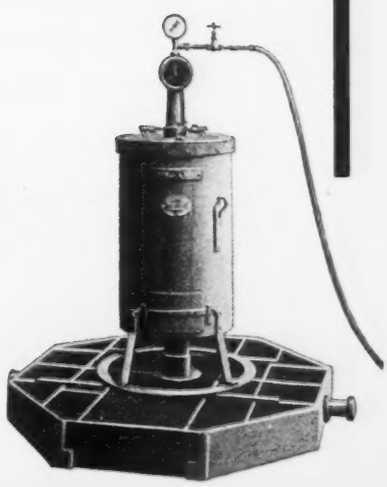

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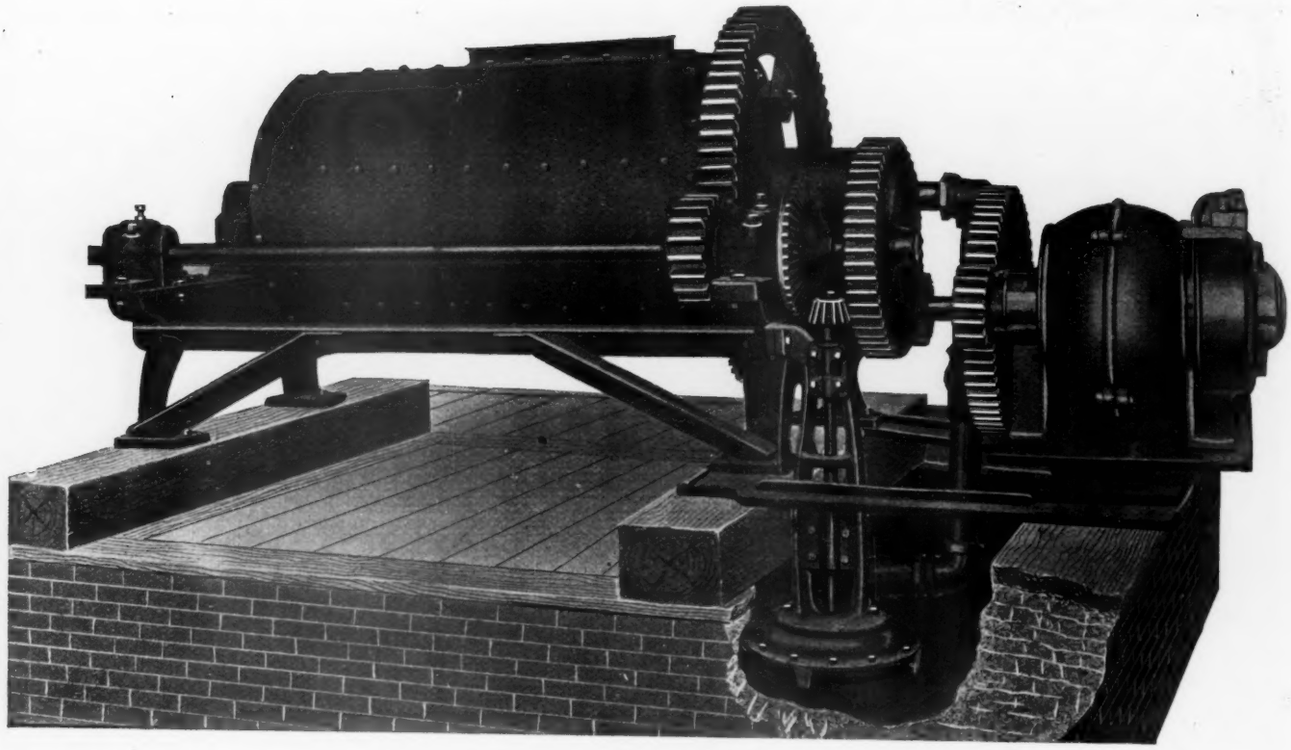

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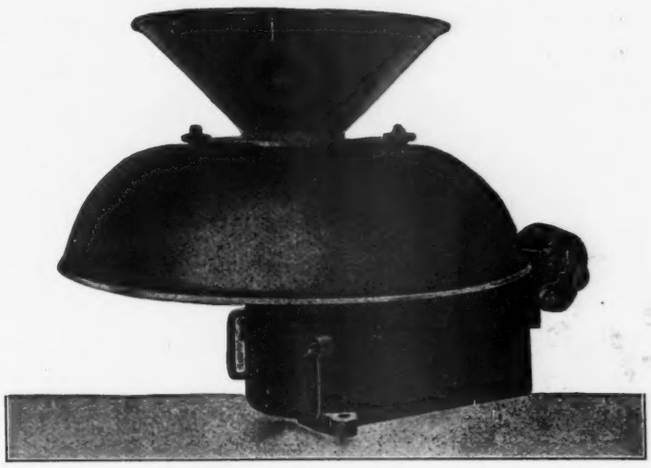

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The Manufacture of Malleable Castings

Dr. Richard Moldenke, than whom there is no greater authority on malleable practice, will discuss every phase of this process for the readers of The Foundry. The first of this series is published in this issue, and the succeeding instalments will appear monthly hereafter until completed. The development of this industry in the United States, as presented by Dr. Moldenke, reads like a novel. Yet, despite the alleged mysteries of the process and the secrecy maintained by the manufacturers, the proportionate tonnage increase in the last decade is unparalleled by any other branch of the foundry business.

The subject will be treated in a practical way, but the metallurgical will not be overlooked.

These articles will prove intensely interesting to the proprietor, metallurgist, chemist, superintendent, foreman and melter, and among the subjects that will be discussed are the following:—

Mixtures—Cupola, Air Furnace and Open-Hearth.

Melting Processes.

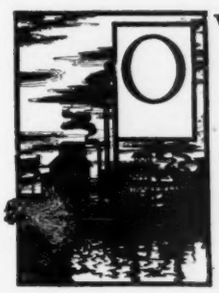
Annealing Processes.

Fuel for Melting and Annealing Furnaces.

Molding and Casting.

Use of Pyrometers for High Temperature Measurements, Cleaning, etc.

Prize Contest Awards in March Foundry



OWING to the large number of articles submitted for competition in the prize contest conducted by The Foundry, the announcement of the prize awards has been deferred one month.

The March issue will therefore contain the four prize articles as well as several of the others that were entered in this contest.

The careful consideration of the mass of manuscript sent in from practically every civilized country in the world involved a tremendous amount of work, and so many novel methods, short cuts and kinks are described that the task of making the awards is a difficult one. Several articles have been received from Australia and practically every country in Europe is represented, although the majority of the contributions were received from American foundrymen.

Every phase of foundry practice is described in these articles, and those accepted but not receiving cash prizes will be published during the next three or four months.

This contest has proved so successful that we have decided to make it an annual feature.

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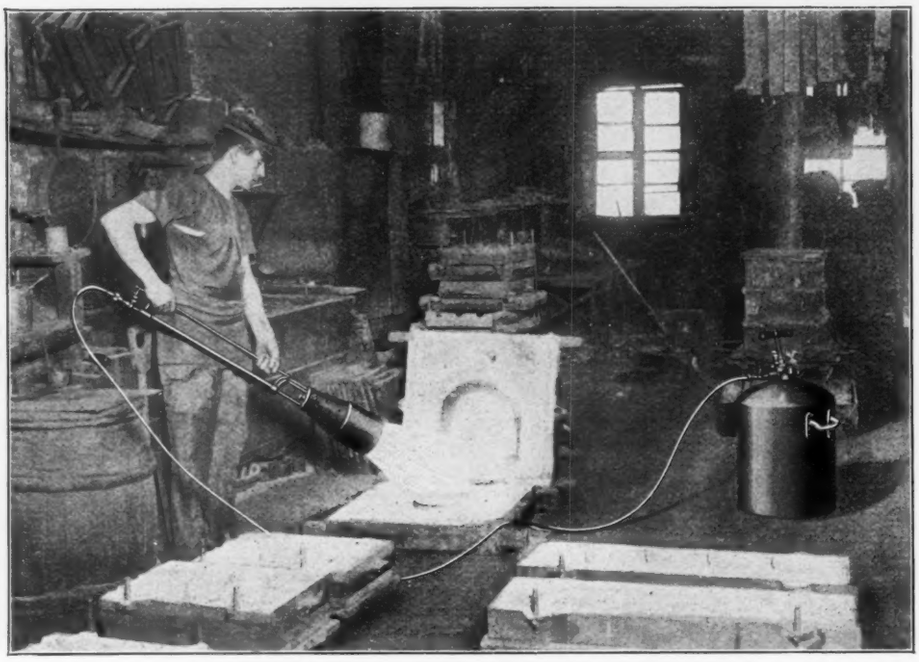

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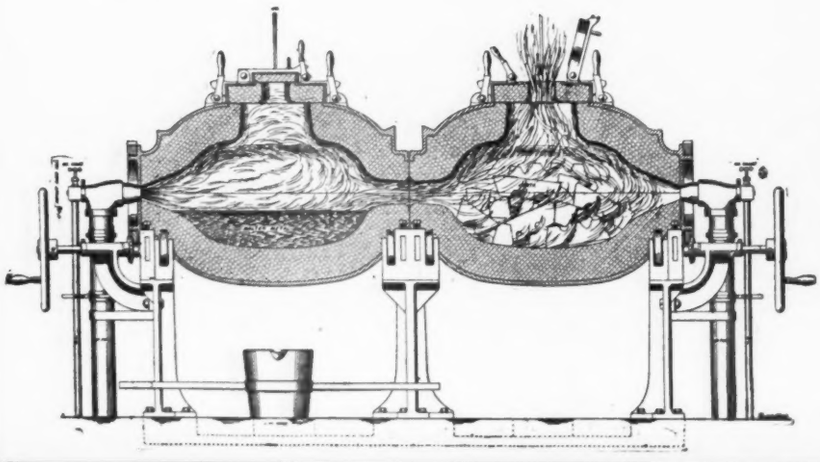

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THE FOUNDRY

Vol. 31, No. 6 CLEVELAND, OHIO, FEBRUARY, 1908 Whole No. 186

PRODUCTION OF MALLEABLE CASTINGS—I

This Article Will be Followed by a Series of Monthly Discussions That Will Cover Every Phase of the Malleable Process

BY RICHARD MOLDENKE

PROBABLY no branch of the iron industry has experienced so little change during the centuries of existence as that of the manufacture of malleable castings. It was only in the last decade that the stormy conditions, incident to this end of the foundry industry, have been mitigated by a greater knowledge of the fundamental principles underlying the various stages of the processes involved. We may safely say, that beyond the fact that white castings made of certain brands of iron, mixed and melted in certain ways and then annealed, would produce serviceable malleable castings, nothing specific which would serve as a guide in daily work was known prior to 1890. There is little to be wondered at in this, as the investigations so far made prove conclusively that by subjecting castings of a composition between definite limits to a proper heat treatment, malleabilization will invariably result. The fact that success, provided the right composition is used, depends solely upon the application of heat at a high temperature for a sufficient length of time to effect a change in the condition of the carbon present and not upon its removal, places the malleable foundry in a unique position. There are few products of the iron trade that can be made either valuable or worthless as a result of a heat treatment and this at a temperature considerably below the melting point. Inasmuch as the processes involved are not difficult to carry out, even by rule of thumb methods, a great industry has been developed in the United States, the production of malleable castings in 1907 having been estimated at over 950,000 tons. The output of European foundries has been placed at about 50,000 tons for this period, England and Germany being credited with the bulk of this tonnage, while France and Italy are only small producers. In the last five years many new plants have been erected and extensive additions have been made to existing works, resulting in an increase of more than 200,000 tons in the annual output.

RICHARD MOLDENKE

The enormous preponderance in the tonnage of the United States is entirely due to the progressiveness of its foundrymen, who did not rest content with the thin sections made in Europe to this day, but increased the weight and thickness of their castings until heavy chills were found necessary to get the metal white when cast. Experiments were continued in this country with a liberal hand for the advancement of the practice, notwithstanding the fact that in no other branch of the foundry industry are the chances for loss as great as in the malleable line. Nor are there any compensating factors in the way of high prices, as competition is very keen. Furthermore, the capital required to operate a malleable plant is at least four times as great as that necessary for a gray iron establishment of equal tonnage. On the other hand, long time contracts for large numbers of the same section insure steady work, and with good contracts in hand it is possible to make a fair profit in prosperous times. Until a very recent date, ignorance on the part of the buyer permitted the founder to do pretty nearly as he pleased, and as a result many castings of an inferior quality were shipped. When accidents occurred, the maker invariably claimed that he used the best of metal, which was true, and so nothing could be done. In

spite of this condition the demand of American builders of machinery and rolling stock was such at all times that malleable castings were sought in preference to gray iron, even when the latter satisfactorily answered requirements. Unquestionably, a malleable foundry located to insure an economical supply of material, with a market for its product and properly conducted, should prove a paying institution.

Historical.

The first record of the production of malleable castings was made by Reaumur in 1722. Technical literature, however, during the next century and a half may be searched in vain for additional light on this subject. Seth Boyden, of Newark, N. J., was the pioneer manufacturer of malleable castings in this country. His recorded experiments stand as a monument to his memory, especially in view of the fact that they were made at a time when all scientific study as applied to industrial problems was frowned upon. Even though he failed to solve the underlying principles involved in the production of malleable castings, he accomplished more than others before him.

It should not be forgotten that in the time of Reaumur, and even Seth Boyden, iron was an expensive luxury used principally for purposes of war. Few could afford to burn up a lot of metal in experiments, which, therefore, were conducted on an extremely small scale. The production of a few tons of malleable castings a week in the early part of the nineteenth century required as much thought and worry as the operation of a modern plant having a daily capacity of 75 tons.

However, from a study of the records, as well as the traditions of the iron industry of the world, it appears somewhat doubtful that the production of malleable castings in a crude and sporadic way must have originated before the eighteenth century. The old slag piles of Hungary tell a story of blast furnace perfection unequaled today, though the cost in fuel must have been tremendous. The ancient disciples of Tubal Cain certainly knew how they wrought, though not why. The forests of Germany had within them many a small forge and hearth furnace adapted from England, in which every variety of steel and iron was made. Since any one can take a No. 6 grade of pig iron and make "malleable" from it by simply annealing with the other castings, it is reasonably certain that the metal gathering at the spout and receiving successive heat treatments, gave the old furnace men a taste of the modern article. This happens daily in furnace practice, as one will find in rebuilding old air and open-hearth furnaces.

Mysteries of the Process.

From time immemorial the manufacturer, then small, now great, maintained the greatest secrecy in his establishment. The spread of knowledge from these old plants reads like a romance. The dissemination of any information regarding malleable practice was not countenanced, as a rival might gain by it. The consumer, however, was not considered. The result was that the plant would work up to a routine which it was believed could not possibly be improved, and what is now termed stagnation or dry rot resulted. In those days the melter was considered the czar of the malleable foundry and his resignation was fraught with danger, as the secrets of the business might be carried away by him. So much were the capitalists in the hands of their melters that they always became partners in the end, and only then changed their tactics.

Reign of the Melter.

It is by no means in the remote past that the melter was known on the floor as "Daddy" so-and-so. He would frequently order a heat held for hours or poured on the floor if for some mysterious reason he did not think it would make good castings. The result was that the molders were compelled to go home early, as their floors were full. The real reason may have been that the melter's "toddy" did not agree with him, or the "super," if not an ex-melter, did not greet him with proper respect. The melter assumed that he knew whether his heat was "high" or "low"—his test plug gave him a clue to this—this being before the days of steel additions, but he was compelled to supplement his eye and sense of temperature by inserting a thin wrought iron rod into the bath, leaving it there long enough to acquire the temperature of the molten metal, then drawing it out and sweeping it through the air. By the scintillations he would judge the fitness of the heat to be poured, providing he was satisfied with the augury of the test plug.

Supremacy of the Molder.

The swishing of the rod through the air was always looked upon with reverence by the molders, whose bread and butter were involved, and great was their satisfaction when the czar looked wise and said, "Give her another 10 minutes and let 'er go." Occasionally, however, the molders took a hand in the game. One of the leaders would get out on the gangway, hold up his shovel, and in 10 minutes all hands would be out on the street endeavoring to ascertain the grievance that so suddenly terminated operations. The heat frequently had to be run out on to the floor and it was usually necessary to make concessions before work was resumed.

This condition was the rule and not the exception in the malleable casting industry in the early days and was founded on, and resulted entirely from the secrecy that surrounded the practice. More could be written on this phase of the subject, but the above will show the great odds that were overcome and the heartbreaking struggles that were experienced by those who brought order out of chaos.

To William McConway of Pittsburg, is due great credit for patiently but persistently supporting the scientific study of the malleable process. The writer desires here to pay tribute to the genius of the man from whom he gleaned much of his knowledge of malleable practice. A knowledge of the sound methods thus worked out was disseminated by the men who went from shop to shop, and with the others at work along similar lines, the practice was revolutionized, these changes having affected not so much the principle of the process as the methods by which they were carried out.

Today, in properly conducted establishments, the iron, mixed by the metallurgist, is delivered to the foreman or melter on the furnace floor, is melted, and is invariably tapped on schedule time. Without doubt the process of malleable casting, called "tempern" in German, was prosecuted in substantially the same manner years ago, the secret having been handed down from father to son in Europe and was subsequently carried over to America from England.

Reasons for Lack of Advancement.

The fact that the process did not advance was in great measure due to the regularity of the pig iron used and the ability of the melter to gage the annealing temperature by the cracks in the brick work of the ovens. The principal requirement in those days, of course, was the change in the carbon from the combined to the amorphous graphitic state. These conditions were sufficient to prevent any advancement in the practice. Reaumur and Seth Boyden left notes ex-

plaining their methods, but the others did not. All of them produced some good and some very poor castings. The old scrap piles bore evidence of this before this material was used in the production of new malleable and at a time when basic steel was not used. Ten years ago nearly all of the older malleable works were making castings by archaic methods, with perhaps some improvement in the furnaces and ovens to increase their capacity.

Introduction of Coke Iron.

The dawn of progress in the malleable foundry followed the introduction of coke iron. Before this, charcoal iron was considered indispensable and the only grade that could be successfully used. The use of coke pig iron was undertaken in fear and trembling and only a very small amount was added to the mixtures. This fact was guarded as a secret, not because of rivals, but to prevent the trade from learning of the cheapening of the product. Doubtless the first place in which coke pig was tried was in a combined gray iron and malleable works. The current belief that pig iron took its "nature" from the ore and exhibited diversified properties was then firmly rooted. Even today the metallurgist who hears of European pig with the names of the ores from which it was made tacked on, or is learnedly told of the difference between northern and southern strong, weak and soft irons, smiles and seeks to be enlightened. The terrors of the malleable man, had he known that his cold blast charcoal was being made by a warm blast process, can only be imagined. The iron salesmen themselves were not advised of this fact, although the furnace operators soon appreciated the value of stoves.

After the prejudice against coke iron was removed, the swing of the pendulum was in the opposite direction and all grades were tried, with the result that all coke grades were soon generally condemned. All kinds of job lot irons, off Bessemer, and grades that should never have entered a foundry, were tried during the hard times late in the nineties and many bad castings were produced. Had a rational way of making mixtures with the new iron been pursued, many of the troubles of the manufacturers and annoyances experienced by the consumers might have been avoided. Today, coke iron for malleable work is especially made. Plenty of coke is used in the furnace with a limited amount of cinder. These grades are known as coke malleables and if they contain less than 0.75 per cent of silicon, can be considered first class.

When coke iron was used in a limited way, it was frequently considered necessary to impress the customer with the fact that the charcoal iron was the mainstay of the mixture. The writer recalls a period when he used coke irons exclusively to the extent of 2,000 tons a month. It was considered necessary to maintain a small stock of charcoal pig iron in the yard on general principles. It is interesting to note that the change from charcoal to coke iron was one of the principal reasons for the reduction in the price of the former material, and today only those plants, which on account of their location find charcoal iron as cheap as coke, are justified in adhering to it for their mixtures.

Use of Scrap.

The introduction of scrap into the mixture marked the next forward stride in the history of the malleable casting industry. Coincident with this was the use of annealed scrap, that is, scrap malleable castings, in new work. This was attempted only by those, however, who were conversant with its use, as many difficulties were encountered. The use of scrap malleable, however, greatly increased the strength of the castings and the time of their introduction marks the change from the ancient to the modern malleable practice.

The chemical laboratory also played an important part in the advancement of the industry, and as a result of the scattering of skilled workers, information regarding modern malleable practice was quickly disseminated. Improvements in equipment speedily followed and these will be discussed in one of the succeeding articles.

The malleable industry today has reached a higher stage of advancement in the United States than in any other country of the world. While the underlying principles of the process are known to but few, there is little excuse for the production of defective castings if proper methods are carefully pursued.

Unsolved Problems.

Further advancement is dependent upon the solution of problems dealing with the constitution of malleable castings. We do not know at the present time why cupola malleables require an annealing heat several hundred degrees higher than air or open-hearth furnace iron. The underlying principles of the oxidation of the bath, which is a frequent cause of defective iron, is practically unknown to the majority of those engaged in this industry. Heats are frequently made that will not pour nor anneal properly, but the causes are still being sought. To produce castings from successive heats so that with the same composition they will have the same physical strength regardless of how they are tested, is a problem partially solved for steel, but not yet approached for malleable cast iron.

Sufficient progress in the study of iron with the microscope has been made to warrant the belief that in the not distant future we may be able to distinguish the constituents of the material by means of etching with various chemicals. When the sulphides and phosphides of iron, or the manganese-sulphur compounds can be seen directly under the microscope it is probable that a method may be found by which the dangerous ingredients may be so scattered or arranged that they will do the least harm.

The book on malleable cast iron has therefore only been opened and with the abandonment of secrecy—really only a mask for ignorance—forward strides may be anticipated that will overshadow all previous advancement.

Each process and every stage of malleable manufacture as it is known today will be described and discussed in this work, and explanations will be made of all of the mysteries which surrounded the practice in the early days and which have disappeared with the application of scientific methods.

ANTIMONIAL MIXTURES.

A four-page folder on "Antimony and Its Relation to Babbitt, Anti-Friction and Other Metals," has been issued by C. W. Leavitt & Co., St. Paul building, New York. It contains the following formulae in which antimony is used: Britannia metal—Antimony, 10 per cent; tin, 90 per cent. Pewter—Tin, 89.30 per cent; bismuth, 1.80 per cent; antimony, 7.10 per cent, and copper, 1.80 per cent. A hard mixture of babbitt suitable for ordinary requirements—Tin, 100 pounds; antimony, 10 pounds; copper, 10 pounds. Another good bearing metal—Lead, 80 pounds; antimony, 15 pounds; tin, 5 pounds. A good linotype mixture—Lead, 83 pounds; antimony, 12 pounds; tin, 5 pounds. An electrotype metal—Lead, 100 pounds; antimony, 10 pounds; tin, 5 pounds.

ANNEALING FURNACE CHARGING MACHINE

Pneumatic Machine Designed to Replace Hand Trucks for Charging Malleable Annealing Ovens

THE CHARGING and discharging of annealing furnaces is by far the most laborious and expensive work connected with the manufacture of malleable castings. In a majority of the foundries the stacks of annealing pots are placed in the furnaces and removed by hand trucks. As the weight of any stack, provided large pots are used, is frequently as high as four tons, six men are always delegated to this work, the number employed varying with the weight of the pots. During the summer months, much difficulty is experienced by the manufacturers in securing men to work at the furnaces, and charges are frequently over-annealed, as a sufficient force can not always be mustered to remove the pots when the annealing has reached the proper stage. Several works have installed furnaces equipped with removable crowns that are lifted off by overhead charging cranes, and the stacks of pots are also lowered into the ovens and removed in this way. The remaining plants utilize the hand truck, which greatly adds to the annealing cost.

Pneumatic Charging Machine.

Realizing that a big improvement could be made in existing charging methods, J. G. Blum, Toledo, who has had a wide experience in malleable work, has designed and is building a pneumatic charging machine that can be operated by one man. A large number are already in use, and stacks of pots are handled by the three sizes of machines, varying in weight from 2,000 to 10,000 pounds. In each instance, from six to 20 men have been replaced on the annealing floor, and the machine is conceded to be the greatest labor saving device introduced into malleable foundries in the last decade.

A front view of the charging machine, showing the lifting forks which pass underneath the stool of the stack, is shown in Fig. 1; a stack of annealing boxes in position on the forks of the machine is shown in Fig. 2, and the operating end and guide wheel are shown in Fig. 3.

Owing to the nature of the work for which it is designed, the machine is of exceedingly heavy construction, the frame being built of I beams 3½ x 6 inches. The beams of the three sizes of machines—10, 12 and 14 feet—are respectively 8, 10 and 12 feet long. The machine is driven by a 15-horsepower air motor of special design, located at the rear near the operator's seat, and is bolted to the frame. The machine is propelled by a chain and sprocket drive, having a compound reduction from the main shaft of the motor to the axle of the main drive wheel. The chains are of the diamond roller bearing type. On the driving axle is mounted a compensating gear which is required to equalize the driving power of both driving wheels, and permits the ma-

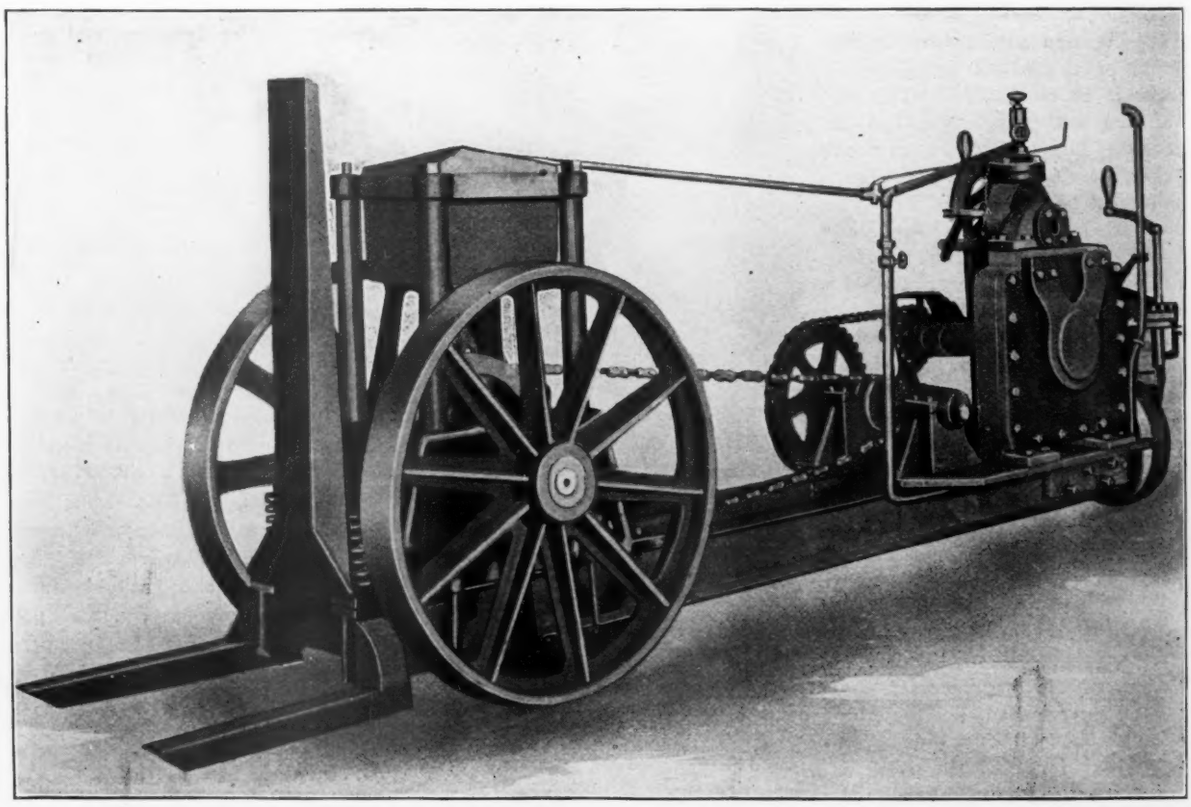


FIG. 1—FRONT VIEW OF PNEUMATIC CHARGING MACHINE SHOWING LIFTING FORKS

chine to turn in an area equal to its own length and to be operated in a confined space, making it adaptable to any annealing floor.

The lifting cylinder, which raises and lowers the forks, is mounted above the large driving wheels, and is secured to the main frame of the machine, the piston in the cylinder in addition having a thrust bearing on the main driving axle. The forks are bolted direct to the main frame, and when air is admitted into the top of the lifting cylinder, this end of the machine is raised, and when the air is released the machine is lowered, thereby lowering the forks. The driving wheels, however, remain stationary.

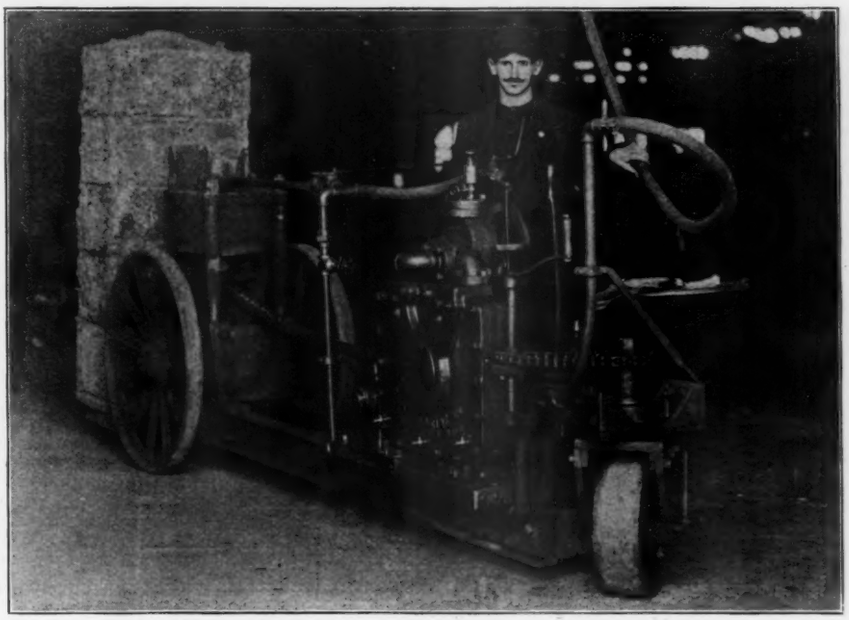


FIG. 2—CHARGING MACHINE WITH STACK OF POTS

The bumper shown above the forks is mounted on springs having a sufficient tension to permit the pots to rest against it, and it automatically adjusts itself to any inequalities in the pots, such as bulging sides, resulting from frequent annealing.

Air Transmission.

Air is transmitted to the cylinder through a pipe connected with the main air line, and the operation of the cylinder is controlled by a lever connected with the 3-way cock. The engine throttle is operated by a foot lever underneath the operator's seat, and a hand lever controls the reversing mechanism. The guide wheel shown in Figs. 2 and 3 is controlled by a chain and sprocket connected with a hand lever. This wheel is made very heavy, and has a chilled surface to withstand rough service.

Air is piped from a compressor to suitable points in front of the annealing furnaces, from which it is carried by a hose arranged in festoons from an overhead trolley. This arrangement gives the air transmission medium its requisite flexibility and permits the machine to operate in and out of the furnaces and on any part of the annealing floor. Provided with 200 feet of hose, the machine will operate over an area of 50 x 200 feet. The air pipe to the engine, with which the hose is connected, has a height of about 4 feet above the

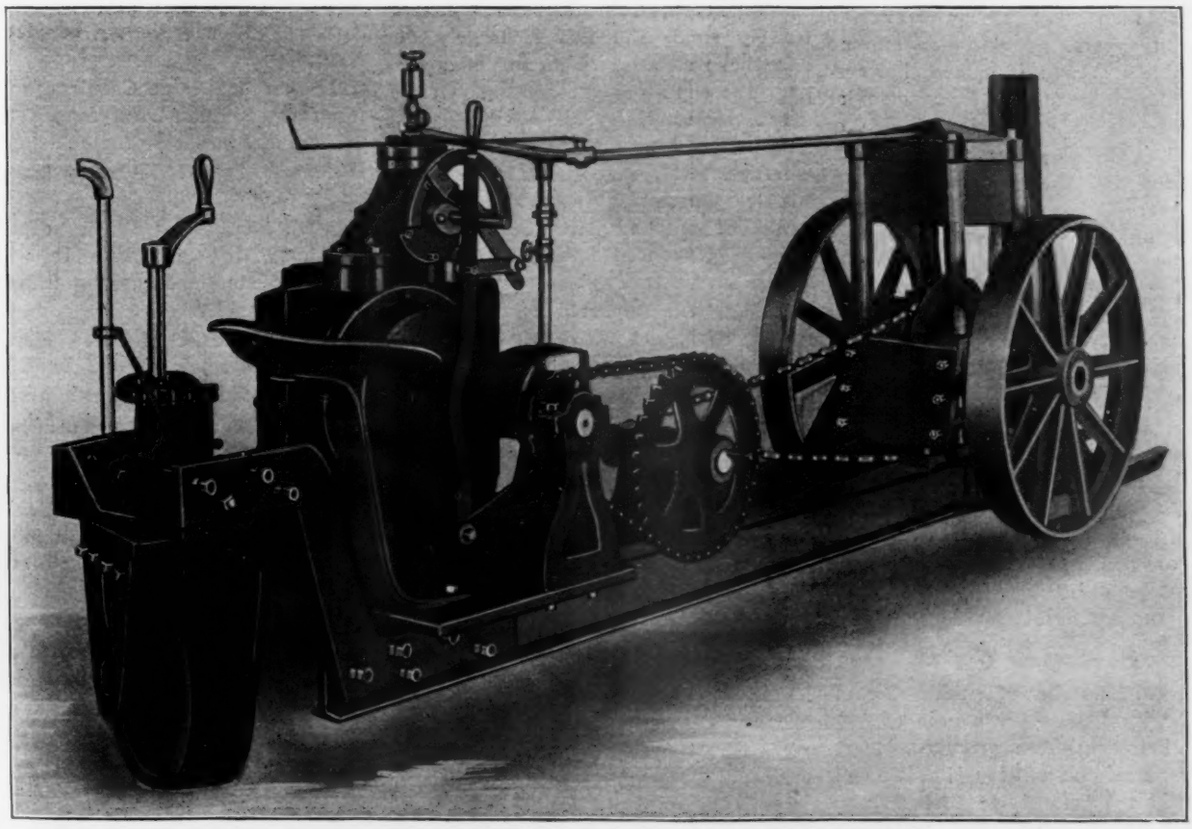


FIG. 3—OPERATING END OF PNEUMATIC CHARGING MACHINE

floor, giving an additional working space of 16 feet, and it further serves to keep the hose from dragging.

With a competent operator, the machine can charge or unload one stack a minute. This was recently accomplished in a 100-pot furnace, which required eight men three hours to load and the same time to discharge, the pots being hauled an average distance of 150 feet from the furnace, the stacks ranging in weight from 2,500 to 4,500 pounds. An air compressor with a capacity of 150 cubic feet of free air per minute is of sufficient size to operate one of these machines. The air consumption, however, will vary with the size of the pots handled and the speed at which the machine is operated.

THE MALLEABLE IRON INDUSTRY IN 1907

Production Last Year Greatest in the History of the Trade—New Plants and Additions to Melting Capacity

NO BRANCH of the foundry trade has recorded as rapid a growth in recent years as the malleable iron industry. This is the more remarkable in view of the substitution of many malleable sections by steel castings especially for railroad work. To the increase in the output of agricultural implements is largely ascribed the phenomenal development of this industry, although the demands of builders of freight and passenger cars for malleable castings have been unparalleled in the last three years.

Production in 1907.

From reports received from the malleable manufacturers, the output in 1907 was 969,399 tons. No comparison can be made with the production of previous years, as statistics are not available. It was estimated, however, that the producing capacity of operative works in the United States on Jan. 1, 1903, was approximately 875,000 tons, and the production for that year was placed at 750,000 tons. The producing capacity, which is now estimated at 1,291,484 tons annually, shows an increase of more than 400,000 tons in four years. In the malleable industry it is exceedingly difficult, however, to make deductions regarding output from the producing capacity, as the nature of the work on which a foundry is operating will govern the tonnage of good castings, and even when the melt is normal, the output may only amount to 50 per cent of the melt owing to the high percentage of discard in the form of gates, runners, etc.

Number of Works.

The total number of works, as compared with 1903, show a gain of only 15, 131 having been reported in operative condition on Jan. 1. Pennsylvania is the only state that suffered a loss in the number of its plants, while Ohio shows an increase of four, Connecticut and Michigan two each, and Illinois, Indiana, Iowa, Kentucky, Missouri, New Jersey, New York, Washington and Wisconsin, one each. Illinois and Ohio lead with 21 works each, while New York and Pennsylvania rank second with 16 each. Illinois, however, leads all other states in output, having produced 205,155 tons in 1907, while Ohio ranks second with 138,830 tons.

Development in the West.

This industry has reached its greatest development in the west, notably in the states of Illinois, Indiana, Ohio and Wisconsin, while in the east, New York and Pennsylvania are by far the largest producers. The output of the 11 plants in Connecticut is comparatively small and this is largely due to the preference of its manufacturers for the cupola as the melting medium. The largest individual plant in the country contains 13 furnaces and its output last year was nearly 45,000 tons. One plant reported a production of only 250 tons, although its cupola was used largely for melting gray iron. In the east a number of small plants reported less than 500 tons each, and with one exception, the works melting their iron in cupolas have comparatively small capacities.

Melting Equipment.

Reports were also received from the manufacturers regarding their melting equipment. These indicate that the cupola is still extensively used in malleable works, no less than 42 being operated on white iron. The air furnace, however, leads with no less than 369 installations and malleable iron is also melted in 21 open-hearth furnaces. The capacity of the air furnace is also being rapidly increased and several plants have recently installed furnaces having an output of from 25 to 35 tons per heat. The open-hearth furnaces average 20 tons, although one of 35 tons has recently been built. There has been practically no change in annealing equipment, although several plants have discarded charging boxes entirely and pack their castings in scale in the furnaces.

The number of small plants operated in 1903 and 1907, as well as their capacities and output is shown in table 1. Their melting equipment is shown in table 2.

New Construction.

Four malleable iron plants are under construction at present, as follows:

Benton Harbor Malleable Foundry Co., Benton, Harbor, Mich.—This plant will be equipped with one 12-ton air furnace and will shortly be placed in operation.

Ironton Malleable Co., Ironton, O.—Melting equipment will consist of two 25-ton air furnaces.

Tiffin Malleable Iron & Chain Co., Tiffin, O.—This plant is under construction and will be completed within a few months. It will be equipped with one melting furnace of 15 tons capacity.

H. W. Cooper Saddlery Hardware Mfg. Co., Moline, Ill.—This plant is nearing completion and will be placed in operation early in the spring. It will be equipped with two air-furnaces of 10 tons capacity each.

Marinette Iron Mfg. Co., Marinette, Wis.—This concern is contemplating the erection of a malleable plant, although plans have not yet been prepared.

New Plants.

Since July 1, 1906, no less than 13 new plants were placed in operation. During this period the malleable industry recorded its greatest growth. A list of these works is given below:

Terre Haute Malleable & Mfg. Co., Terre Haute, Ind.—Two 12-ton air

furnaces. Placed in operation, October, 1906.

Hoopeston Malleable Iron Works, Hoopeston, Ill. — Placed in operation Oct. 1, 1907. Melting equipment consists of one 15-ton air furnace.

Rockford Malleable Iron Works, Rockford, Ill.—This concern occupied its new plant in June, 1907. The producing capacity, as compared with the old plant, will be practically doubled, the melting equipment consisting of two 25-ton air furnaces.

T. H. Symington Co., Corning, N. Y.—This plant was placed in operation about a year ago and is equipped with one air furnace of 12 tons capacity.

Globe Malleable Iron Co., Syracuse, N. Y.—Placed in operation September, 1906. The melting equipment consists of three air furnaces of 12 tons capacity each.

Columbus Malleable Casting Co., Columbus, O.—This plant was placed in operation August 23, 1907, and its melting equipment consists of two air furnaces of 10 and 12 tons capacity each.

Lack Malleable Iron Co., Paducah, Ky.—Placed in operation Sept. 1, 1907. Iron is melted in one cupola.

Galesburg Malleable Casting Co., Galesburg, Ill.—This plant, equipped with one air furnace, was placed in operation Sept. 1, 1907.

Fanner Mfg. Co., Cleveland, O.—This plant was placed in operation April 1, 1907. It is equipped with two air furnaces, of 15 tons capacity each.

David Bradley Mfg. Co., Bradley, Ill.—Commenced operations July, 1906. Plant is equipped with one 5-ton open-hearth furnace and two 15-ton cupolas.

South Side Steel & Malleable Casting Co., Milwaukee, Wis.—Placed in operation October, 1906. Equipped with two 15-ton air furnaces.

Allegheny Valley Malleable Iron Co., New Kensington, Pa.—This plant was first placed in operation late in 1907, and is equipped with two air furnaces of 30 tons capacity each.

Morse Iron Works, Erie, Pa.—Equipped with one 12-ton air furnace. Placed in operation early in 1907.

Additions to Melting Equipment.

The following additions to the melting equipment of existing plants was made during the last 12 months:

Marion Malleable Iron Works, Marion, Ind.—Melting equipment increased by the installation of one 16-ton air furnace.

St. Louis Malleable Casting Co., St. Louis, Mo.—Melting equipment increased by one 20-ton air furnace.

Acme Steel & Malleable Iron Works, Buffalo, N. Y.—Melting equipment increased by the addition of one 13-ton air furnace from 12 to 25 tons.

Illinois Malleable Iron Co., Chicago.—Melting equipment increased by the addition of one 13-ton air furnace.

International Harvester Co., Chicago.—Melting equipment increased by the addition of one 14-ton air furnace.

Erie Malleable Iron Co., Erie, Pa.—Extensive additions to this plant were made during the year and the melting capacity was increased about 3,000 tons annually.

Stanley G. Flagg & Co., Philadelphia, Pa.—Melting equipment increased 25 tons daily.

Table II.

	No. of air furnaces.	No. of open-hearth furnaces.	No. of cupolas used for melting malleable iron.
Alabama	1		
Connecticut	21	1	10
Delaware	6		
Illinois	74	2	7
Indiana	30	5	1
Iowa	1		
Kentucky			1
Maryland	2		1
Massachusetts			3
Michigan	32		1
Minnesota	3		
Missouri	4	2	
New Hampshire	2		
New Jersey	6		
New York	45	1	6
Ohio	62	1	2
Pennsylvania	32	6	7
Rhode Island	1		
Tennessee	4		
Washington			1
West Virginia	1	1	
Wisconsin	42	2	2
Total	369	21	42

Albion Malleable Iron Co., Albion, Mich.—Melting capacity of this plant was doubled within the last 12 months.

Northwestern Malleable Iron Co., Milwaukee, Wis.—Melting equipment increased by the addition of one furnace.

Thomas Devlin Mfg. Co., Philadelphia.—Melting equipment increased by the installation of one 15-ton air furnace.

Chicago Malleable Casting Co., West Pullman, Chicago.—Melting equipment increased by the installation of two air furnaces of 12 and 15 tons capacity each.

Missouri Malleable Iron Co., East St. Louis, Ill.—Melting equipment increased by the installation of two air furnaces, of 15 and 18 tons capacity each.

United States Malleable Iron Co., Toledo, O.—The melting capacity of this plant was increased 3,000 tons during 1907.

Waukesha Malleable Iron Co., Waukesha, Wis.—Melting equipment of this plant was increased by the addition of one 12-ton air furnace.

Ohio Malleable Iron Co., Columbus, O.—Melting equipment increased by the installation of one 15-ton air furnace, and two 12-ton air furnaces were increased to 15 tons capacity.

Ross-Meehan Foundry Co., Chattanooga, Tenn.—The melting equipment of this plant was increased during 1907 by the installation of an additional air furnace of 12 tons capacity.

Beaver Dam Malleable Iron Co., Beaver Dam, Wis.—This concern practically doubled its output within a year, the melting capacity having been increased 9,000 tons annually by the installation of several additional furnaces.

Lakeside Malleable Castings Co., Racine, Wis.—The melting equipment of this plant was increased during the year by the addition of one 15-ton furnace.

Table I.

	No. of works 1903.	No. of works 1907.	Increase in No. of works in 4 years.	Decrease in No. of works in 4 years.	Estimated annual capacity of works operative in 1907. Tons.	Production in 1907. Tons.
Alabama	1	1			3,600	
Connecticut	9	11	2		70,400	56,825
Delaware	1	1			25,000	
Illinois	20	21	1		276,940	205,155
Indiana	5	6	1		116,000	96,600
Iowa		1	1		2,500	
Kentucky		1	1		500	
Maryland	1	1			4,000	
Massachusetts	3	3			3,200	3,000
Michigan	6	8	2		94,200	70,700
Minnesota	1	1			12,000	
Missouri	1	2	1		11,600	11,600
New Hampshire	1	1			4,500	
New Jersey	3	4	1		11,250	8,625
New York	15	16	1		152,394	123,107
Ohio	17	21	4		198,000	138,830
Pennsylvania	18	16		2	163,650	109,060
Rhode Island	1	1			1,800	
Tennessee	1	1			13,000	
Washington		1	1		500	
West Virginia	1	1			5,500	
Wisconsin	11	12	1		120,950	91,297
*Scattering						54,600
Total	116	131	17	2	1,291,484	969,399

*This includes the 1907 production of Alabama, Delaware, Iowa, Kentucky, Maryland, Minnesota, New Hampshire, Rhode Island, Tennessee, Washington and West Virginia.

National Malleable Castings Co.—The melting capacity of one of the Chicago plants of this corporation was materially increased by the installation of several furnaces.

Grand Rapids Malleable Iron Co., Grand Rapids, Mich.—Melting capacity doubled by the erection of four additional air furnaces.

Malleable Plants in the United States.

A list of the works engaged in the manufacture of malleable castings in the United States is given below:

Alabama.

Western Steel Car & Foundry Co., Anniston.

Connecticut.

Bridgeport Malleable Iron Co., Bridgeport.

Eaton, Cole & Burnham Co., Bridgeport.

Fitch, W. & E. T. Co., New Haven.

Malleable Iron Fittings Co., Branford.

Malleable Iron Works, New Britain.

Naugatuck Malleable Iron Co., Naugatuck.

North, A. B., Co., New Haven.

North & Judd Mfg. Co., New Britain.

Terry, Andrew Co., Terrysville.

Vulcan Iron Works, New Britain.

Woodruff, Walter W., & Sons Co., Mt. Carmel.

Delaware.

Wilmington Malleable Iron Co., Wilmington.

Illinois.

American Car & Foundry Co., Madison.

Bradley, David, Mfg. Co., Bradley.

Chicago Malleable Castings Co., West Pullman, Chicago.

Cooper, H. W., Saddlery Hardware Mfg. Co., Moline.

Crane Co., Chicago.

Forster, Waterbury & Co., Franklin Park.

Galesburg Malleable Iron Co., Galesburg.

Hoopeston Malleable Iron Works, Hoopeston.

Illinois Malleable Iron Co., Chicago.

International Harvester Co., 2 plants, Deering and McCormick, Chicago.

Missouri Malleable Iron Co., East St. Louis.

Moline Malleable Iron Co., St. Charles.

National Malleable Castings Co., Chicago, two plants.

Parlin & Orendorff Co., Canton.

Pratt, William E., Mfg. Co., Joliet.

Rockford Malleable Iron Works, Rockford.

Union Malleable Iron Co., East Moline.

Western Steel Car & Foundry Co., Chicago.

Western Tube Co., Kewanee.

Indiana.

Haskell & Barker Car Co., Michigan City.

Marion Malleable Iron Works, Marion.

National Malleable Castings Co., Indianapolis.

Oliver Chilled Plow Works, South Bend.

Terre Haute Malleable & Mfg. Co., Terre Haute.

Whiteley Malleable Castings Co., Muncie.

Iowa.

Iowa Malleable Iron Co., Fairfield.

Kentucky.

Lack Malleable Iron Co., Paducah.

Maryland.

Baltimore Malleable Iron & Steel Castings Co., Baltimore.

Massachusetts.

Arcade Malleable Iron Co., Worcester.

Belcher Malleable Iron Co., Easton.

Worcester Malleable Iron Co., Worcester.

Michigan.

Albion Malleable Iron Co., Albion.

Benton Harbor Malleable Iron Co., Benton Harbor.

Buhl Malleable Co., Detroit.

Grand Rapids Malleable Iron Co., Grand Rapids.

Michigan Malleable Iron Co., Detroit.

Port Huron Engine & Thresher Co., Port Huron.

Standard Malleable Iron Co., Muskegon.

Western Malleable Steel Co., Detroit.

Minnesota.

Northern Malleable Iron Co., St. Paul.

Missouri.

American Car & Foundry Co., St. Charles.

St. Louis Malleable Casting Co., St. Louis.

New Hampshire.

Laconia Car Co., Laconia.

New Jersey.

American Malleable Co., Bloomfield.

Barlow Foundry Co., Newark.

Meeker Foundry Co., Newark.

Trenton Malleable Iron Co., Trenton.

New York.

Acme Steel & Malleable Iron Works, Buffalo.

American Malleable Co., Lancaster.

Deposit Foundry Co., Deposit.

Frazer & Jones Co., Syracuse.

Globe Malleable Iron Co., Syracuse.

Gould Coupler Co., Depew.

International Harvester Co., Osborne Works, Auburn.

Johnson, Isaac G., & Co., Spuyten Duyvil.

Oriskany Malleable Iron Co., Oriskany.

Pratt & Letchworth Co., Buffalo.

Symington, T. H., Co., Corning.

Syracuse Malleable Iron Works, Syracuse.

Torrance Malleable Iron Co., Green Island, Troy.

Troy Malleable Iron Co., Troy.

Westmoreland Malleable Iron Co., Westmoreland.

Wood, W. A., Mowing & Reaping Machine Co., Hoosick Falls.

Ohio.

American Malleable Castings Co., Marion.

Canton Malleable Iron Co., Canton.

Chisholm & Moore Mfg. Co., Cleveland.

Columbus Malleable Castings Co., Columbus.

Dayton Malleable Iron Co., Dayton.

Eberhard Mfg. Co., Cleveland.

Elbel Co., Canton.

Fanner Mfg. Co., Cleveland.

Findlay Axe & Tool Co., Findlay.

Haven Malleable Castings Co., Cincinnati.

International Harvester Co., two works, Champion Works and Champion Branch, Springfield.

Ironton Malleable Iron Co., Ironton.

National Malleable Castings Co., Cleveland.

National Malleable Castings Co., Toledo.

Ohio Malleable Iron Co., Columbus.

Pittsburg Valve & Fittings Co., Barberton.

Springfield Malleable Iron Co., Springfield.

Tiffin Malleable Iron & Chain Co., Tiffin.

United States Malleable Iron Co., Toledo.

Zanesville Malleable Iron Co., Zanesville.

Pennsylvania.

Allegheny Valley Malleable Iron Co., New Kensington.

Devlin, Thos., Mfg. Co., Philadelphia.

Erie Malleable Iron Co., Erie.

Flagg, Stanley G., & Co., Philadelphia.

Fort Pitt Malleable Iron Co., Pittsburg.

Jarecki Mfg. Co., Erie.

Kelly & Jones Co., Greensburg.

McConway & Torley Co., Pittsburg.

Meadville Malleable Iron Co., Meadville.

Morse Iron Works, Erie.

Oil Well Supply Co., Oil City.

Pennsylvania Malleable Co., McKees Rocks, Pittsburg.

Phila. Hardware & Malleable Iron Works, Philadelphia.

Pittsburg Malleable Iron Co., Pittsburg.

Sterlingworth Railway Supply Co., Easton.

York Mfg. Co., York.

Rhode Island.

Rhode Island Malleable Iron Works, Hills Grove.

Tennessee.

Ross-Meehan Foundry Co., Chattanooga.

Washington.

Acme Malleable Iron Foundry Co., Puyallup.

West Virginia.

West Virginia Malleable Iron Co., Point Pleasant.

Wisconsin.

Beaver Dam Malleable Iron Co., Beaver Dam.

Belle City Malleable Iron Co., Racine.

Globe Foundry & Machine Co., Sheboygan.

Lakeside Malleable Castings Co., Racine.

Milwaukee Malleable Iron Works, Milwaukee.

Northwestern Malleable Iron Co., Milwaukee.

Racine Malleable & Wrought Iron Co., Racine.

South Side Steel & Malleable Casting Co., Milwaukee.

Stowell Mfg. & Foundry Co., South Milwaukee.

Waukesha Malleable Iron Co., Waukesha.

West Allis Malleable Iron & Chain Belt Mfg. Co., West Allis.

Wisconsin Malleable Iron Co., Milwaukee.

MOLDING A LARGE CYLINDER CASTING

Method Pursued in a Southern Jobbing Foundry—Large Sectional Core

BY C. R. McGAHEY

WHILE there are many methods of molding cylinders, I will describe a system pursued in our foundry located in the sunny south. Thjs casting had a diameter of 7 feet inside, was 6 feet high and the metal in the barrel was 1¼ inches thick. The flanges had to finish 2 inches thick. This was made in a small foundry, with the ordinary jib crane as the lifting medium.

We gave this to a molder of some experience who, after digging out his pit, placed his sweep socket as shown at A, Fig. 1. He next struck up his bed for his core or champe plate, as shown at B, Fig. 2. He then laid his cinder bed and led four vent pipes up to the floor level from the cinder bed, as shown at C, Fig. 2. The next step after laying the champe plate was to make the bed with the strike at O. We took pains to make this firm, but well vented into the cinder bed, as the iron had to fall on this flat surface for some distance and it was necessary that the vents led off freely. When this was done we laid in our flange cores as shown at E, Fig. 1, which formed the bottom flange. When we had these nicely trimmed and the joints well made, we proceeded to ram up the side walls. For this we used a piece of boiler plate. To make speed we had a segment rolled a portion of the circle and about one-half or more of the height as shown in Fig. 3. The two holes in it enabled us to swing it on the crane chains and we braced it from the rear side of the mold with wooden braces and rammed the sand solid, and vented it well with a large wire rod leading to the surface of the mold. We continued this operation until the entire circle was

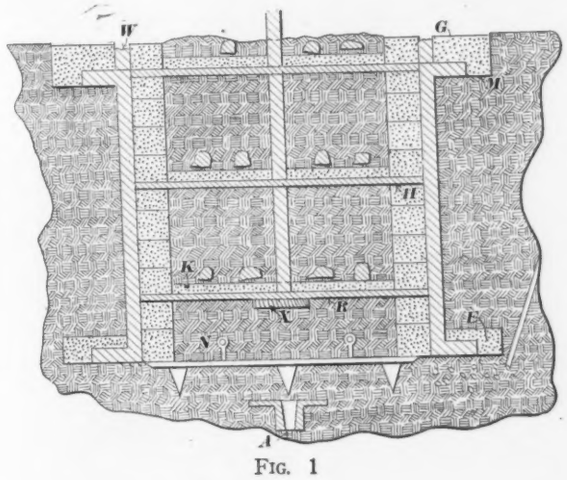


FIG. 1

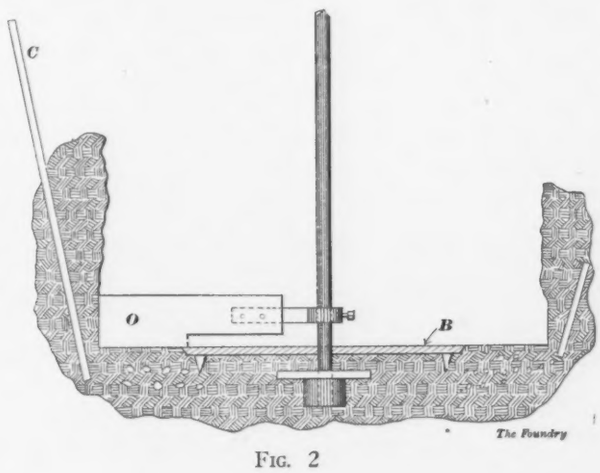


FIG. 2

FIG. 3

rammed up and then put in our strike, shown in Fig. 4.

We next commenced to strike our surface or vertical wal's of the mold, which we did carefully, ramming with the butt rammer whenever it was necessary, to get a firm mold to stand the pressure one of this kind is subjected to. When this was done, we struck our top at M, Fig. 1. This we did with strike Y, the same one having been used on the bottom when a good surface was secured. We then laid our flange cores and set them so that they were true, and rammed in the sand behind as shown. The mold was finished with a good, heavy, silver lead blacking brushed on dry.

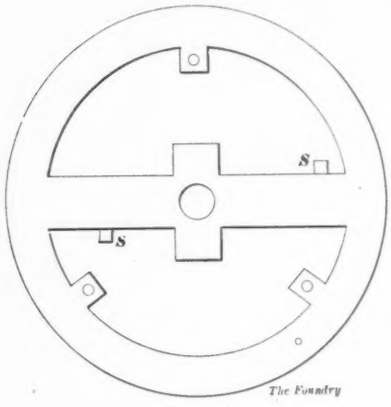


FIG. 5

The building of the core next engaged our attention and this was constructed on champe plate B, the sections and their size being shown in Fig. 6. Paste was used between the joints of the various courses, and when the proper height was reached a gate was cut through three sections of the core as shown. We then laid another course, and so on, until we reached the top.

When the core was built we hooked on our crane to the eye bolts N, Fig. 1, and drove our guide stakes as shown at S, Fig. 5. Then we lifted our core and placed it on the foundry floor, smoothed up the joints, cleaned off the surplus paste and blacked the core with good wet blacking. When this operation was finished we built a fire around the core and dried it until we felt sure that the surface was baked. In the mean time we sprayed our mold with syrup water and dried it well with a fire in the bottom of the mold. When we were sure our mold was dry, we cleaned out our bed and set in our core, and then commenced to make the gates. We rammed up the sand until we reached the first gate openings in the core and laid our center core at X. This was used to keep the iron from cutting when falling. The gate sprue was then cut and the covering cores were put on as shown at K, Fig. 1. Green sand and pig iron were rammed in, repeating the operation until the top was reached.

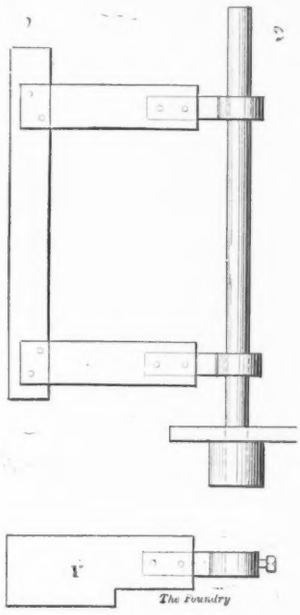


FIG. 4

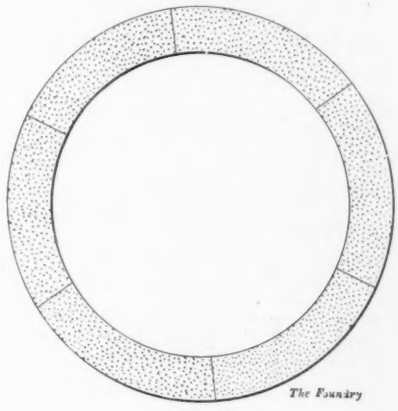


FIG. 7

The pig iron was used to prevent the core from floating or rising. We also weighted down the top of the mold at G, Fig. 1, to prevent the flange from raising the cores. This casting was poured with a riser, as shown at W. Fig. 7 shows a ring of the cores of which the main core was made. The runner box was of the ordinary type used in foundries making heavy work.

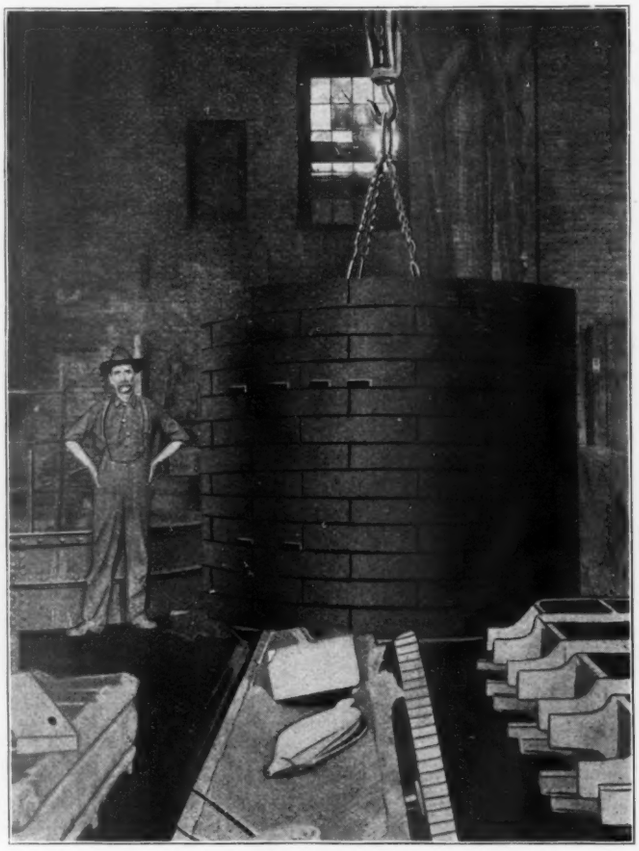


FIG. 6

YELLOW BRASS CASTINGS.

Question:—We are having some trouble in making brass scale beams which are 42 inches long, ⅜ inch thick and 1½ inches wide. The castings have the appearance of being badly scabbed and pitted. We use a yellow brass mixture and would like to have you suggest some mixture that will insure clean castings.

Answer: — Perhaps your sand is at fault. To ascertain this, make two molds and vent both the cope and the drag with a needle vent, then dry and cast. If the castings are clean your sand is at fault and you can remove the difficulty by purchasing a more open sand. The following mixture will give you a clean casting yellow brass: Copper, 16 pounds; zinc, 7 pounds; tin, ¼ pound; lead, ¼ pound.

MACHINE MOLDED DROP HANGERS

Combination Stripping Plate and Vibrator Machines—Special Flask Equipment—Floor Stand on Roll-Over Machines

THE accurate mounting of patterns is the underlying principle governing successful molding practice. To secure the greatest economies from these tools, with which every foundry doing any amount of duplicate work should be equipped, frequently requires patterns especially made for repetition work. Although the initial cost of the equipment is heavy, nevertheless the expense, spread over a large number of castings, is infinitesimal for each section.

In the foundry of the Falls Rivet & Machine Co., Cuyahoga Falls, O., molding machine practice has been carried to a high degree of development. This concern manufactures power transmission machinery, as well as other kindred lines, and a part of the product, particularly drop hangers, owing to the large number annually produced from each pattern, is readily adaptable to molding machine work. All of the hangers made at this plant are machine molded, and even the heavy floor stands have been mounted on machines of the roll-over type. No expense has been spared to make the equipment complete in every detail, which has resulted in greatly reducing the cost on this line of work.

The foundry, built many years ago, is by no means modern in its arrangement, yet economies have been effected that exceed those frequently attained in many shops more recently designed by the most skillful engineers.

Problems of Mounting the Patterns.

When the company decided to manufacture side adjustment, ring oiling drop hangers, George H. Wadsworth, works superintendent, was confronted with the problem of mounting no less than 71 sets of patterns on molding machines. The patterns for the double braced hangers made in the shop at that time were all mounted on stripping plate machines. The first cost of the plates was enormous, inasmuch as the pattern openings were evidently cut and dressed out of the solid. Notwithstanding the advances which have recently been made in the preparation of these plates, it was found that the first cost of mounting these new sets of patterns would be very heavy, and a plan was devised by which the necessity of making the entire stripping plate for each pattern was overcome.

Stripping the Hanger Feet.

Six stripping plate machines of three different sizes, to be operated in pairs for the production of the cope and drag parts of the molds, were purchased. Instead of stripping the entire pattern, it was decided to strip the feet only, this plan having been adopted to secure a smooth bearing surface for the feet to obviate all machining, as the hangers are now frequently adjusted to the steel members of buildings. The remainder of the pattern is dropped away from the mold, as on any ordinary stripping plate machine. This is clearly shown in Figs. 1 and 2, the first showing the patterns in position for ramming, and in Fig. 2 the draw plates with the patterns are shown in the lowered positions they assume when dropped away from the molds. The stripping plates are also shown fitted to the machines.

Vibrator.

The vibrator question also received careful consideration and a vibrator bar, attached directly to the pattern, was decided upon in preference to a vibrator frame. This was another radical departure that has proven eminently satisfactory. The bar is doweled to the pattern and is attached by means of coun-

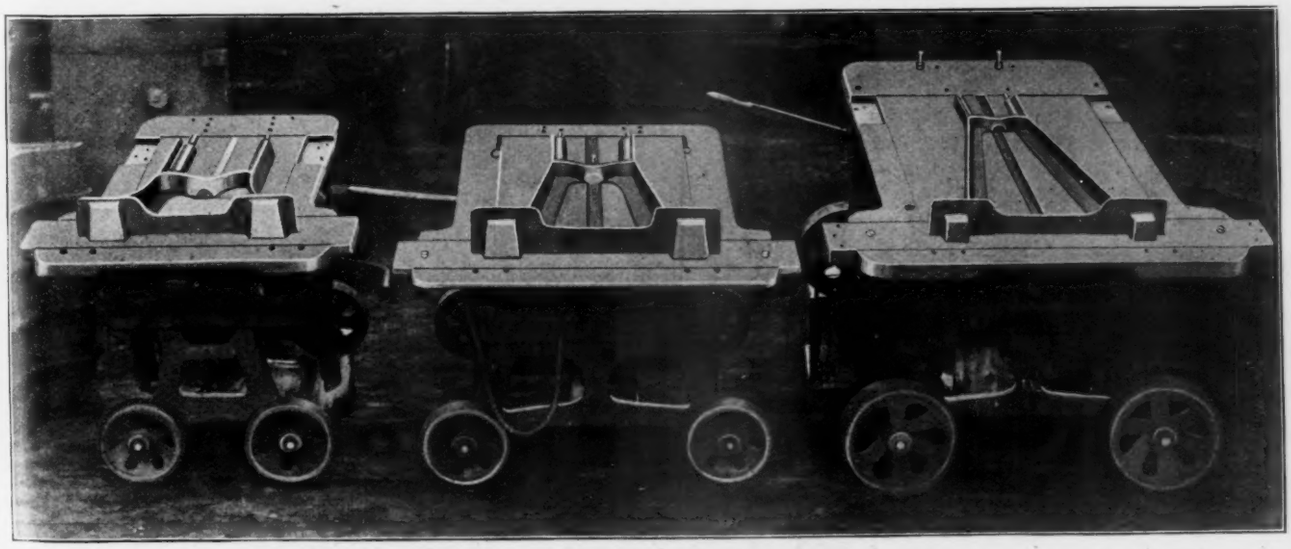


FIG. 1—PATTERNS FOR DROP HANGERS SHOWN IN POSITION ON THE THREE SIZES OF MACHINES. THE SIX MACHINES THAT COMPLETE THE EQUIPMENT ARE OPERATED IN PAIRS FOR MAKING THE COPE AND DRAG PARTS OF THE MOLDS

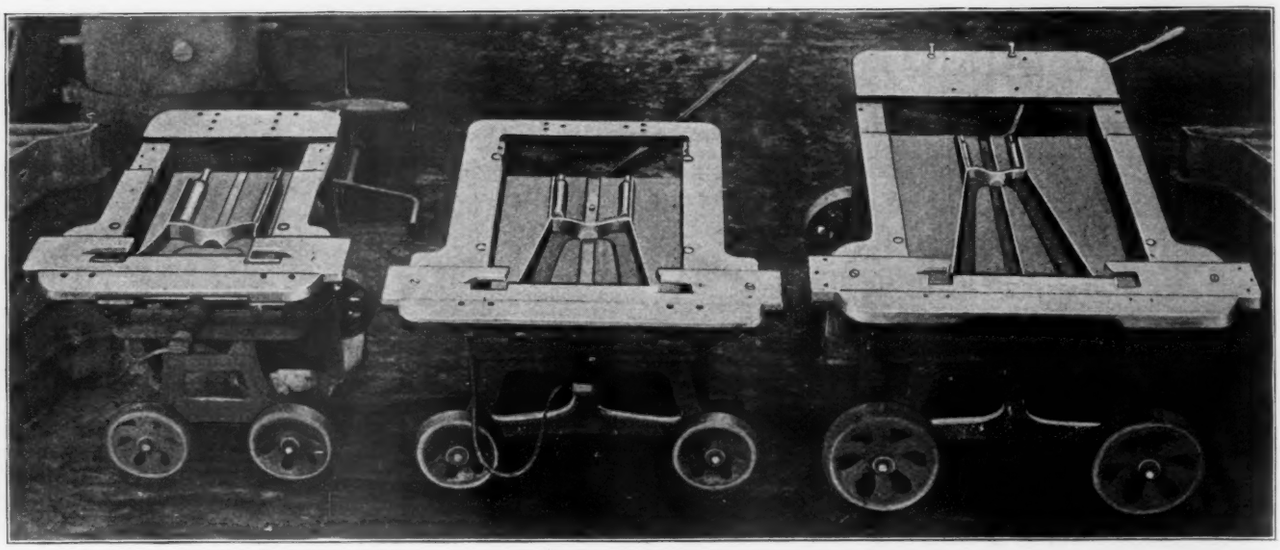


FIG. 2—THE PATTERNS ARE SHOWN DROPPED AWAY FROM THE MOLD. THE STRIPPING PLATES FOR THE HANGER FEET ARE CLEARLY INDICATED

tersunk screws. The front and reverse sides of three half patterns of various sizes with the bars attached are shown in Figs. 3 and 5. The draw plate of the machine is slotted for the vibrator bar, which is fastened to the plate with countersunk screws that fit in slotted holes in the latter, permitting a 1/64-inch movement of the bar, whereby the vibrating of the pattern is accomplished.

Stripping Plates.

Three of the stripping plates are shown in Fig. 9. These are made of cast iron, the pattern being outlined with white metal. This method, generally pursued in making stripping plates, has greatly reduced the cost of manufacture, as compared with the outlining of the pattern in the solid plate. The stripping plates are made by casting the white metal against the pattern to secure an accurate definition of the hanger feet, the iron casting which forms the greater portion of the plate being recessed to hold the metal in place.

The patterns of the 71 sizes of drop hangers have been so arranged that they can be mounted on the three pairs of machines respectively, 16 x 18 inches, 20 x 24 inches and 24 x 36 inches. On the large machine 23 sets of patterns can be mounted, while on the other two 24 each.

Patterns.

The patterns are all made of cast iron, and to give them a smooth finish they were immersed in a weak bath of sal-ammoniac and water for about ten days. The coating of rust was then thoroughly rubbed off with sand paper before the beeswax was applied. The application of the wax to such a large number of patterns involved considerable work and many difficulties, and it was finally decided to immerse the castings in a vat of boiling water until they reached the temperature of the latter. It was found that the heat imparted was sufficient to melt the wax which flowed freely. After the wax had set, the patterns were polished with a soft brush, and this surface successfully withstands both the action of the sand and the damp atmosphere usually prevalent in the foundry.

Storing the Patterns.

A special rack was built in the pattern storage, located in an adjoining building, for the various sets of patterns and stripping plates. Compartments have been partitioned off for each hanger set, which are carefully designated by the size of the hangers and the plates, and the patterns are similarly stamped. This method insures the storage in their proper compartments of the pattern plates, together with the patterns with which they are used, and in this way can always readily be located when required.

Special Flasks.

To complete the equipment for these hangers, a special set of cast iron flasks was designed, as shown in Fig. 4. At the left is one of these flasks showing its machined face with the bars removed, and at the right is a five-barred flask with one bar removed to show the recesses in which the bars are held. Four of the bars are shown in the center of this view. The flasks are made in 12 different sizes, and no less than 200 are in use. The number of bars varies from three to nine, according to the size of the hanger mold. The shape of the flasks conforms to that of the hanger shown in Fig. 10, this form greatly reducing the amount of sand required in the mold, the minimum

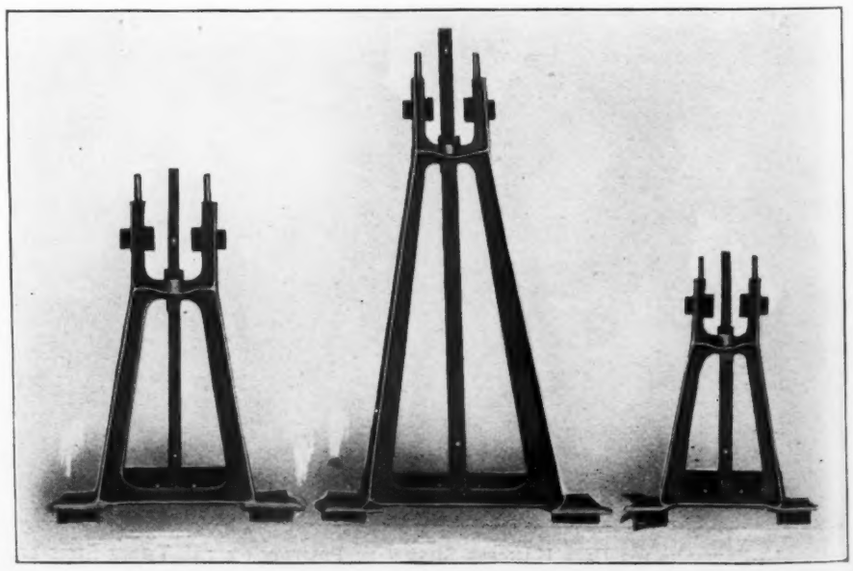


FIG. 3—FRONT VIEW OF PATTERNS SHOWING VIBRATION BARS

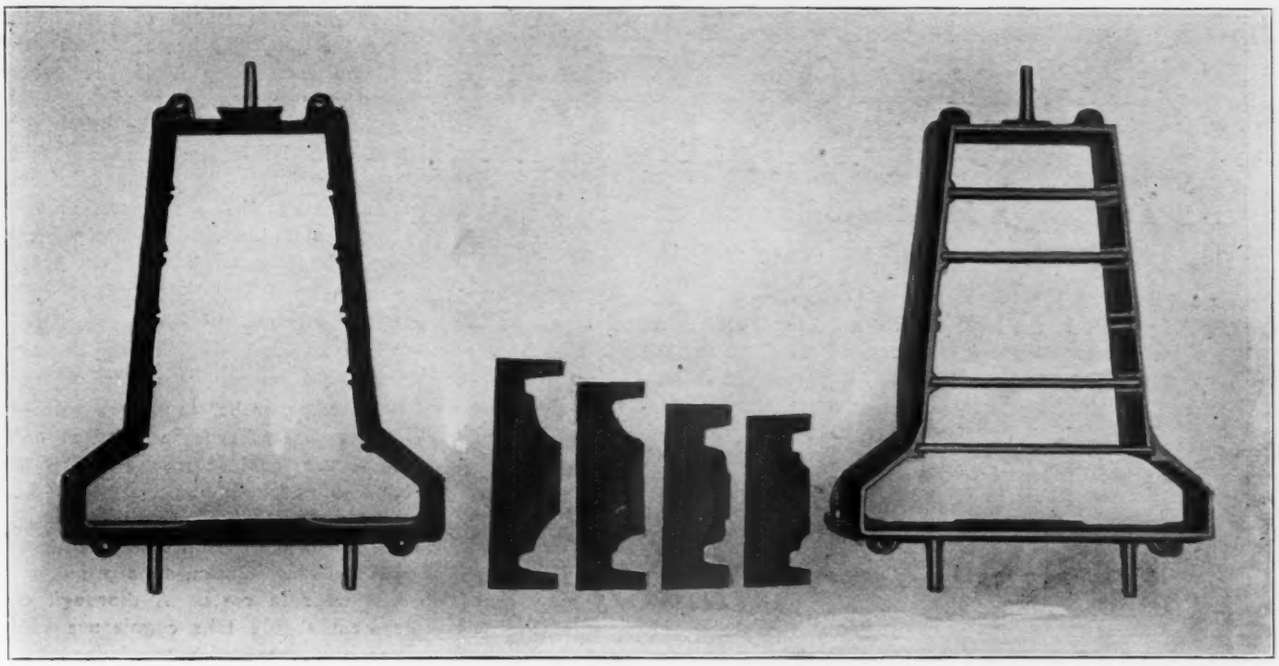


FIG. 4—SPECIAL BARRED FLASKS AND SET OF BARS

amount, however, permitted between the flask and the pattern being one inch. The minimum amount of sand provided for between the bars and the pattern is ¼ inch, and bars of various widths are used to accommodate the different sizes of angles.

The cost of this entire equipment was considerably above $20,000, and while this may be considered high, nevertheless the ensuing economies have been in direct proportion to the expenditure. The flask yard adjoining the foundry, showing the special flasks, is shown in Fig. 11.

Stripping Plate Machine of an Ancient Type.

The stripping plate machine installed in this foundry 20 odd years ago, of which four are still in use, is shown in Fig. 7. On the stripping plate are shown the half patterns for a double braced hanger, as well as the openings for hanger caps. These machines, now rammed by hand, were equipped with a squeezer operated by a lever and has a capacity for flasks up to 30 x 40 inches. Some of the plates have been built for stripping four of the smaller hangers, as well as the same number of caps in one operation. The plates made for these machines were also of an unusual thickness, and range from 1¼ to 1½ inches.

Roll-Over Machine.

Large floor stands are molded on a roll-over machine that has proven its adaptability for the various kinds of patterns that can be satisfactorily mounted on it. It is shown in Fig. 6 with the half pattern of a floor stand attached to the molding board. The flask shown in position in Fig. 8 is 36 x 48 inches in size, notwithstanding that the machine dimensions are only 24 x 24 inches. When rammed with the bottom board attached, the flask weighs about 800 pounds, and to facilitate the rolling over of the mold an air hoist is used. When made on the floor, one of these stands is considered a day's work for a molder and a helper, while on the machine four are now being made in the same length of time by two men.

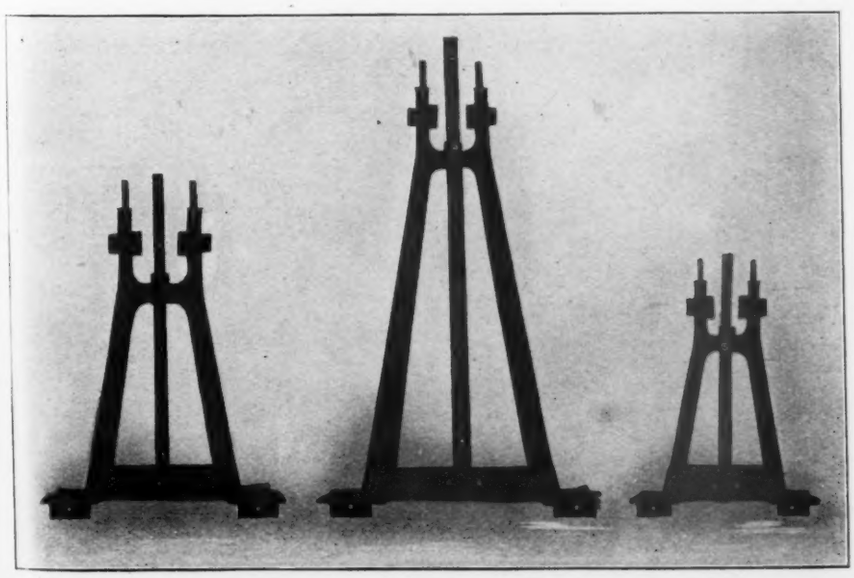


FIG. 5—REVERSE SIDE OF PATTERNS SHOWING METHOD OF ATTACHING VIBRATOR BARS

COST FINDING.*

BY KENNETH FALCONER

The value of many efficient systems of cost finding, not alone in the foundry industry, but in other lines of manufacture is frequently lost by a failure to fully realize the end and aim of cost finding. In planning a cost system, whether for a foundry employing one molder and a helper, or for the largest industrial establishment in existence, it should always be borne in mind that the finding of costs is a means to an end. The justification of any cost system is in direct proportion to its influence towards increased profits. This influence may be exerted along one or more of several lines by the reduction of costs, increased sales and the elimination of unprofitable business.

*An abstract from a paper presented at the January meeting of the Pittsburg Foundrymen's Association.

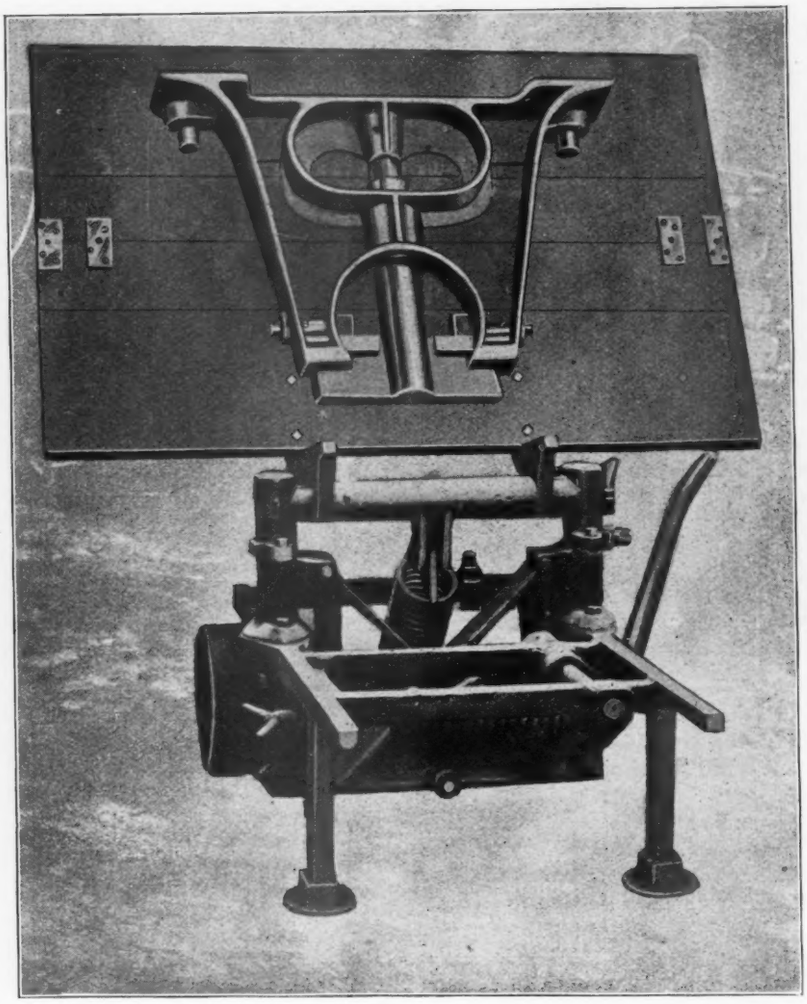


FIG. 6—ROLL-OVER MACHINE WITH HALF PATTERN OF FLOOR STAND MOUNTED ON THE MOLDING BOARD

Increased Profits.

An efficient cost system should tend towards increased net profits. Viewed from this standpoint a system of cost finding becomes as direct an influence towards increased profits as any mechanical betterment of plant, or any improvement of the selling organization. A manufacturing plant is a productive tool, its general organization being the cutting edge; a cost system is the test whereby the management is able to keep the cutting edge in the best possible condition, and to secure from the operations of the tool the maximum efficiency.

Another essential point in a cost system is that the information secured by it shall always be a matter of current record—not ancient history—that the facts presented may be used before conditions have so changed as to make the information of no interest or real value.

Another point frequently overlooked in devising and installing cost finding methods is the harmonizing of such methods with the general scheme of commercial accounting. To secure the best results, methods of cost finding and the general scheme of accounting should each be part of one general plan covering records of all operations and transactions from the purchase of raw material to the shipment of finished product. The data and information secured by the operation of a cost system should be susceptible of proof by comparison with the general results of the business as reflected from time to time in the general books.

Distribution of Costs.

There are other important considerations to be borne in mind in order to secure the best results of any system of cost finding. Among these may be mentioned the tabulation of results in such manner as to automatically draw attention to any abnormal variations in costs. A thorough cost system should take cognizance of all costs of the business, which broadly speaking, may be divided into three classes, cost of production, cost of administration and cost of selling. The cost of product is composed of three factors, material, direct labor and manufacturing expense.

In planning a record of the cost of manufactured product, it is not always advisable in the beginning to undertake an analysis of expense cost to the extent to which it will be ultimately carried. It is advisable to get the cost system running accurately showing the three factors of the cost of product, namely direct labor, direct

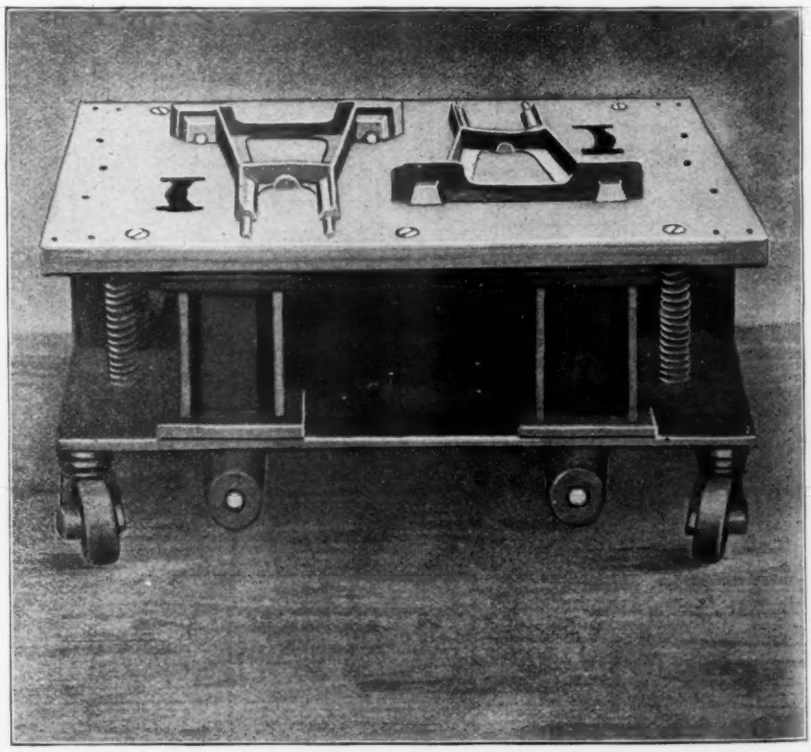


FIG. 7—A STRIPPING PLATE MACHINE OF THE EARLIEST TYPE

material and general expenses, and then gradually installing methods by which the expense may be analyzed to such degree as to afford an opportunity for studying and comparing the different items which go to form this cost with a view to lessening it.

Recording Results.

Recording the results of similar operations and transactions in parallel columns, month by month, does not always convey as much meaning to those interested in the welfare of the business as recording the information each month in conjunction with items of related interest for the same and current months. Figures in themselves often fail to convey information which may be seen at a glance by means of curves and diagrams. For instance, if the labor cost per pound increases a fraction of a cent each month for 12 months, and this information is recorded in figures it will of course be immediately noticed. If, however, the labor cost fluctuates, increasing slightly one month, deceasing the next, but always increasing a shade more than decreasing one will hardly have the fact of the constant increase brought so clearly to mind as if the information were recorded by curves and diagrams, showing at a glance the constant upward tendency of the labor cost.

Investigations by Foundry Organizations.

Among those engaged in the manufacture of iron castings there has, in recent years, been a tendency to organize for the purpose of adopting some uniform method of costs. Committees of the Stove Founders' Association, Malleable Iron Founders' Association and the American Foundrymen's Association have been formulating plans for adoption by their various organizations, whereby some degree of uniformity in cost finding methods may be secured. On the part of those interested in foundry cost keeping this is not pure philanthropy. Most foundrymen will acknowledge that ruinous and dangerous competition comes from the manufacturer who does not know his costs, but who bases his selling price either on general market conditions, or on what the other fellow quotes.

FIG. 8—ROLL-OVER MACHINE WITH FLASK IN POSITION. MOLD WEIGHS 800 POUNDS. AN AIR HOIST IS USED TO FACILITATE THE ROLLING OVER OPERATION

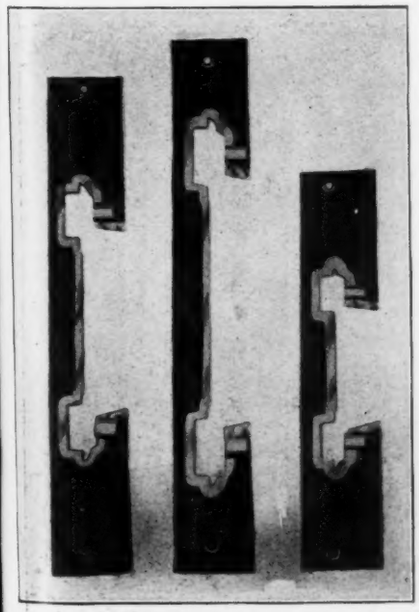


FIG. 9—STRIPPING PLATES FOR THE HANGER FEET

In finding the cost of castings, as in finding the cost of any other manufactured product, it is always well to draw a definite line of division of cost covering operations up to a defined point. It is generally recognized that a foundry cost system should show the cost of molten metal as the first defined point, followed by clear lines of definition between the several stages of completion. A foundry cost system which simply takes note of the average cost per pound of castings produced would probably work very satisfactorily if it could be applied to a foundry producing from month to month, castings of exactly the same size, weight and quality. Where the output is composed not only of castings varying in weight but which also represent a spread in the cost of labor, the average cost per pound is a misleading basis on which to estimate or to figure costs, profits, or losses.

Cost of a Variety of Product.

The statement is frequently made that it is impossible to secure accurately the cost of each individual casting made in a foundry turning out a variety of product. However, the use of one average rate per pound is absolutely misleading and unreliable. Between this and the cost of each individual casting a compromise is to obtain the cost of product by classes.

If the output of a jobbing foundry

is divided into two clearly defined classes, and the average cost of each class is recorded, this plant will come closer to securing the correct costs of its product than a competitor who uses only an average cost per pound for the entire output.

Division of Product Into Classes.

The number of classes into which it is advisable to separate the product depends in each case on existing circumstances and conditions. I have in mind now a brass foundry which some years ago was dividing its output into two kinds of castings, red and yellow; the division of cost between the two was an arbitrary one, fixed largely by the ruling market price of copper and the guess of a very intelligent foreman. That foundry turned out a variety of brass castings ranging in weight from a nut for a basin cock to a tuyere weighing perhaps 300 pounds. The output ranged from a cast handle for a compression bib to an intricate British coat of arms measuring approximately 4 x 6 feet and weighing perhaps 4,000 pounds.

This foundry is now dividing its output into eight or nine classes and is keeping a record of the cost of individual castings to a greater extent than formerly. This system, the proprietor recently told me, had proved of real dollars and cents value to him in figuring the cost of his finished product.

CHICAGO ASSOCIATED FOUNDRY FOREMEN'S EXHIBIT.

With one exception, all of the manufacturers of foundry supplies and equipment who made exhibits at the exposition of foundry equipment held under the auspices of the Chicago Foundry Foremen, at the Lewis Institute, last year, have decided to place molding machines and other equipment on exhibition at the Lewis Institute on March 5, 6, and 7. Last year the exhibits were assembled in

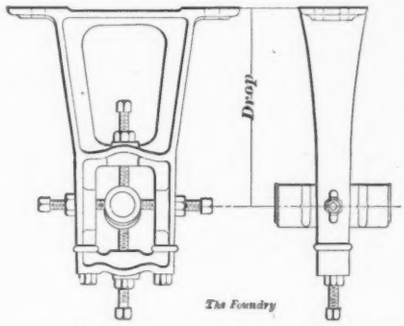


FIG. 10—SIDE ADJUSTMENT, RING OILING DROP HANGER

the foundry of the Institute, but more space will be devoted to this feature at the coming exposition. Large molding machines, pneumatic tools, and oil furnaces will be placed in the basement laboratories and meetings in connection with the convention will be held in one of the rooms on the first floor. Patternmakers' tools, core machines, hand power molding machines and other light equipment will be placed in the foundry on the sixth floor of the engineering building. As the management of the Institute provides the space and power, exhibitors will be under no expense whatever.

A request has been made that all exhibits be shipped during February, in care of C. E. Hoyt, Lewis Institute, and upon their arrival in Chicago they will be carted to the building and set up, thus obviating the necessity of sending a representative to take charge of this work. Heats will be made daily in the school cupolas, and molds made on the machines will be cast during the convention. The exposition last year was attended by nearly 600 foundrymen, and a still greater attendance is anticipated in March.

MIXTURES FOR CYLINDERS AND BEARINGS.

By C. VICKERS

Question:—Kindly favor us with the following mixtures: Heavy duty, slow running engine bearings; mixture suitable for hydraulic cylinders, which should be acid-proof; suitable mixture for white brass that is not too soft and will polish like nickel plate.

Answer:—Bearing mixture — Copper, 84 pounds; tin, 10 pounds; phosphor tin, 2 pounds; lead, 4 pounds.

Hydraulic cylinders — Copper, 86 pounds; tin, 8 pounds; phosphor tin, 2 pounds; lead, 4 pounds.

White brass — Copper, 20 pounds; nickel, 10 pounds; aluminum, 4 ounces.

FIG. 11—FLASK YARD SHOWING STOCK OF SPECIAL FLASKS

LIMITATIONS OF THE MOLDING MACHINE*

A Discussion of the Origin and Development of Molding Machine Practice

BY E. H. MUMFORD

THE recorded art of molding by machinery is far older than that of the steam engine, and there lacked only today's demand for multiple parts and the facilities for developing the art to have put it where it is now a hundred years ago. Thus, just as soon as a stripping plate was needed, it was "invented"—more than a hundred years ago and as soon as a foundryman felt the vibration of a pneumatic hammer he used what we now call a "vibrator" to help draw a guided pattern.

About 20 years ago S. Jarvis Adams, Pittsburg, jolt-rammed molds for pipe balls and wagon axle boxes; yet even today the modern jolt ramming machine at an exhibition attracts a crowd of foundrymen amazed at its novelty.

It was their long years of experience with the subtle and elusive behavior of green sand in the presence of melted metal in the secret intimacies of the closed mold that led molders some sad years since to scoff at molding machines and to foretell their doom unaided by the molder's skill.

And molding machines have failed—machines of much ingenuity—heralded as labor savers because they did so many things done before by hand. These machines have failed because of too many opportunities for failure in a single enchained mechanism. Before the heartless biting cynicism of foundry ethics many a clever engineer has come to grief. Where melted iron rules and sand intrudes with every lubricant, refinements of machine design may not be much elaborated.

*From a paper presented at the annual meeting of the American Society of Mechanical Engineers.

Early Failures.

And so, though the patent office is filled with ingenious molding machines, most of them have failed as the molder prophesied, while the art of machine molding has steadily progressed. It is still eliminating the machines which bring the sand in from the yard, temper it, riddle it and ram it, pass themselves their flasks, sand frames, sprue cutters and other accessories, draw their patterns, deliver the finished molds and have only to be restrained from setting the cores.

It is assimilating a good simple efficient machines content to do a few things well.

It is not speed of production of blocks of sand which look like molds and which in the halcyon days of "demonstrated" machines often passed as such and sold the machine even while the "demonstrator" walked around upon them which in 1907 proves the machine. The present day molding machine must take what the foundry gives it and turn back what the foundry wants—molds in quantity and of quality excelling in economy of production, the product of hand labor in castings or it gets no welcome there.

But there is another reason for the markedly gradual and cautious development of the molding machine. It is the infinity of shapes and kinds of patterns around which green sand must be rammed with uniformity of mold surface, and the necessity of arranging some more or less universal method of withdrawing these patterns from the rammed sand without in the least degree displacing it.

In other fields it has paid the most brilliant mechanicians of the age to develop elaborate and expensive machines for doing one kind of work always. Our machines for making cigarettes, envelopes and paper bags are fair examples. For molding machines there is no one casting of a certain size and shape in required quantity comparable with cigarettes, etc. At the speed of the envelope machine, a few molding machines would supply the demand of the entire country and in any one shop a single machine would run far ahead of its market in a day or a week or a month, and then waste its shop room.

Machine Limitations.

Another limitation to the exploitation of molding machines to make molds as bricks are made lies in the fact that these machines, unlike those for making bricks, do not finish their work. Sand and flasks must be supplied to the machine and castings must be poured and cooled and shaken out. It would not be difficult to design a machine which would mold for example, 200 shoes per hour, and such machines have, in fact, been built. Each machine, however, would call for 5,000 pounds of sand and as many pounds of flasks to be delivered to it and carried away from it again every hour. Even then the molds are in halves and without cores set; 200 cores must be set and 100 copes closed on every hour. To keep the "floor" from gaining on the foundry, 5,000 pounds of hot metal must be poured from double hand ladles every hour, which work would keep from four to six men busy pouring and shifting weights. As many more men would be required to shake out and remove hot castings, and at least two more to get the flasks off of the floor again. Only a little foundry experience will prove that this situation is impossible.

The elaborate foundry structures for dropping both sand and castings through the floor still leave the labor of setting cores, handling and closing molds, pouring and shaking out to be performed. In fact, we are far from the realization of a molding machine which will turn out castings, as do the type casting machines and all machines which cast mildly hot metal in

chills, and which may not be called molding machines as their molds are already prepared. The mold which melted iron will not destroy and which will not exaggerate unequal cooling of the casting surface, with resulting evils, is no nearer our commercial use than is the Philosopher's Stone and, until it is, the molding machine, delivering only incomplete sand molds, will still invoke the genius of the designers who know where to limit its functions, and the ignorance of those who do not.

Ramming.

Sand will flow only slightly under pressure, hence pressure and blow ramming machines fail to reach deep parts because shallower parts absorb the pressure.

Sand, especially in pressure ramming, is subjected to great friction in its movement down the sides of patterns and flasks—hence even directly vertical pressure over deep parts does not ram them down all the way.

After sand is partially set in a mold, by pressure or other means, it has taken the shape of the pattern, and if it is moved, it carries this pattern shape—as of a corner—with it. Thus a blow of a hand rammer at one side of the sand, compressed by a previous blow, shifts that partially rammed sand aside, and generally away from the pattern.

In jolt-ramming machines a peculiar ram off effect occurs at every convex corner of a pattern. This is due to previous jolting having set the sand over the pattern at the corner, with the result that little of it can follow out and down past the corner to take the place of the deeper sand which the later blows of the jolting cause to settle down the more or less vertical sides of the pattern.

In vibrator frame machines, called such, though the same term may be applied to any machine using an undivided pattern with extensions from the patterns to guides outside the mold, the effect of ram-off is commonly produced by springing of the unsupported pattern during ramming—it being immaterial whether the movement be in the sand or the pattern.

Barred Flasks.

Flask bars have been a limitation more or less serious in all molding machines. Taking all kinds of bars into consideration, including those which spring under jolt or pressure ramming, there are few which do not give trouble, or cause loss of time, if we except the so-called "floating bars," and even these must be nicely proportioned to depth of sand, etc.

Pressure-ramming machines must employ special ramming blocks to cut away to clear bars. Jolt-ramming machines require that the bars shall be very thin, and yet not spring, for if a bar shakes off the contact of the sand and the frictional bond between the sand and the bar is destroyed, the bar merely aggravates the tendency of the sand to drop from the flask, by cutting it into channels and unsupported blocks.

The writer knows of only one bar that will hold the general mass of sand, after the sand has actually separated from its under edge. It is one which has been designed specially for jolt-ramming and tested with complete success and it permits the sand to settle away from it in the cope, while keeping the mold from "coping," as the runner fills up; for it holds the sand down as well as up.

The floating bar, whose action is ideal, if its descent into the sand under it is properly controlled, is an element in what is known as bottom-ramming, and the action is the same whether the bar only, or the bar and the flask which holds it, moves toward the pattern in ramming.

Ramming Patterns Down or Sand Up.

It is impossible to ram sand up into an inverted pattern, as is required in making a drag mold without rolling. The pattern must first be filled and surrounded with sand. Rathbone did this first in 1905. He was using a blow-ramming machine, with an inverted drag pattern on a match board for producing multiple molds, and found that the projection of the unrammed sand against the pattern an instant before ramming—a result incidental to the apparatus he used—accomplished what had not been done before.

Mismatch.

It is assumed that patterns and flask pins are accurately fitted; this match is caused by the following conditions:

a—Cope and drag parts of the pattern on separate carriers—nothing but a miracle can insure accurate match, for all the errors due to misfits of the dowels, etc., enter in, as they do not when the same rigid piece carries both parts.

b—The pattern carrier separated from the part of the machine containing the flask pins. An apparent exception to this is the ordinary stripping plate machine, when patterns are new. In this case, the pattern may move out of match, but the new stripping plate with flask pins in it, in sliding over them, forces them into place.

c—Lack of support of joint surface during pattern drawing downward causes sagging of joint.

d — Bottom boards and match boards springing under ramming produce the amorphous joints last referred to by causing convex drag joints, if the ends of boards have sprung into molds, and concave drag joints if the centers have sprung in. A prolific source of this failure in machines is the use of skids instead of flat tables in pressure-ramming machines. For example, with 2½-inch skids, placed 10 inches apart, the center of the board of a mold 14 inches long will be sprung in, producing a concave drag joint; while the ends of the board of a mold, 28 inches long, will be sprung in and a convex drag joint result.

If from any cause the two point surfaces of a mold are not perfectly flat, or, if not flat, perfectly inversely similar, such a joint will "creep" out of match in closing. For this reason better matched molds are obtained from stripping plates, which support the point during pattern drawing.

In the first use of vibrators on machines, the slight lateral freedom of the pattern carrier necessary with reference to the mold was secured by the proper freedom of a match plate on the flask pins. In the endeavor to improve vibrator action, the pattern carrier was separated from the part containing the flask pins. The idea was that the agitation and dropping of the sand while drawing patterns down would be thus avoided. While this was, in a measure, accomplished, the clearances thus introduced allowed the patterns to shift out of match during ramming and led to the introduction of automatic locking devices dependent upon springs.

Broken Corners.

Stripping plates know no such failures, for their essential function, as indicated by their French name "peignes"—combs, is to comb the sand along the edges of the pattern. But, in those machines which employ vibrators to start the edges of sand, three things are necessary:

a—Clean and well drafted edges of the patterns.

b—Absolutely straight movement of these edges relatively to the sand, or vice versa.

c—Flasks undistorted by clamping or otherwise.

In the matter of clean joint edges, an interesting detail has within the last few years developed. Split pat-

terns on match plates are frequently hollowed out to save weight and metal, and all patterns have more or less air space between them and the plates. Mr. Walker, at Erie, found that at the moment of ramming by pressure, the air under the patterns is compressed to the 30 to 50 pounds pressure of the mold, and that, to effect this compression, the very damp air in the unrammed sand is forced under the pattern—then, immediately, when the pressure is taken off of the sand, this imprisoned damp air issues from this hollow under the edges of the patterns next to plate. This constant breathing in and out of wet air causes wet corners, to which the sand adheres.

This has led Mr. Walker to adopt the plan of sweating his patterns on a tinned plate. The little fillets of solder which run up along the pattern edges, help the pattern draft very materially. The slightest touch of a pattern on the sand corner that is leaving takes at least a little of that corner with it.

It is an axiom in machine molding that all pattern draft must be taken from the mold joint, and that this joint must be maintained without deformation until the mold is closed.

Sizes and Shapes of Molds.

Molding machine makers are now in a position to say to the trade that the mere size of a mold is no reason for not making it by machinery. This is very evident in the case of hand-ramming machines where the problem of furnishing from 15 to 100 pounds ramming pressure to every square inch of area is not encountered, and in the most widely known hand machines, where the ends of the frames which carry the stripping plates are left open, any length of flask within the width capacity of the machine may be accommodated, provided the length is not sufficient to cause too great an overhang.

Until this year, America has not known familiarly a complete molding machine that would handle for both ramming and drawing patterns any size or shape of mold for which it had ramming capacity. Consider for a moment what it has meant to the introduction of molding machines that a power machine has been used for, at most, three or four sizes of flasks, the only latitude being in width, and this limited to a narrow maximum.

Our technical press has lately been filled with descriptions of a French molding machine and its equally interesting pattern equipment. The able Frenchmen who have evolved this mechanism have christened it "Universal," with an intensity of meaning characteristic of the deep thought which has produced it.

It is not necessary here to describe this remarkable machine and its fit companions, the Plaques Modeles and Cliches Tables which promise to reduce our molding machine pattern costs from 50 to 90 per cent.

Ramming Soft, Deep Sand.

All the French machines may be fitted at a trivial cost with double serrage—an appliance for double-ramming. This is simply an auxiliary plunger under the mo'd table of the machine, set quickly to stop gage, to which are attached what we call in the United States "stools." While the main ramming pressure is on, these stools, which have receded to allow a given amount of sand to enter the pocket or cavity, are run against the stop gage and the soft sand is made just hard enough. This procedure is general from Tupper grate bars to deep and intricate green sand cores in automobile castings.

Ram Offs.

Only a single application of pressure is made, and deep vertical sides are rammed from the opposite direction so that no "ram-off" can occur.

Mismatches.

As the flask pins are not in the machine—though they are drawn by the machine—the match is made and maintained in the foundry so that, with full responsibility, the foundry may also have credit for matches more perfect than heretofore.

Broken Corners.

As stripping plate patterns made by the French process are as cheap as the various forms of vibrated patterns heretofore known in America, it becomes much more practicable to adopt stripping plates.

Broken corners are unknown to stripping plates. In fact, except for the cost of the latter, there would never have been use for vibrators in connection with molding except as adjuncts to stripping plates. This is even true of patterns drawn up, especially, as in the inverting French machines, the stripping plates or stools follow the sand down automatically.

Untrue Draft.

There can hardly be truer pattern draft than that guided by the same plunger which has done the ramming as is the case in all the French machines of the rotary or inverting type. The only necessary precedent is that the ramming, or bottom board which has been forced into the flask, if such a one is used, shall have an even seat when the mold which is being lowered on the inverted ramming plunger is leaving the pattern. The slightest difficulty from this source is easily removed by three-point bearings.

In the French machines of the fixed type, the pattern draft datum is taken from the mold joint itself, inasmuch as the columns which raise the stripping plate and the half mold upon it have adjustable tops which are set at the start to conform to the exact surface of the mold.

Flasks Sprung.

Since no clamps are used, there can be no springing of flasks from this cause. Furthermore, I would here mention an innovation illustrating the national differences in everyday practice in the molding methods of two countries, in even these latter days of constant interchange of ideas.

The French use round flasks as commonly as we do square ones. They use snap flasks hardly at all, and yet they obtain from solid flasks what we know only as snap molds.

When it is stated that 220, 21-inch round "snap" molds are produced in a day by two men from "solid" flasks, I know that many will ask "How?"

The molds are made as molds in 21-inch round flasks would ordinarily be made; except that very thin "binders," hoops of steel only 1-32 inch thick, are employed. The drag mold is then set upon a plate on the round table carried by an assembling machine, the table and plate being a little smaller than the inside of the flask. This plate serves as a bottom board. The cope mold is placed above the drag, over long pins common to both parts, so that the match is absolute. The cope flask being locked so that it cannot rise. the plunger rising against the drag carries it up to the cope, closing the joint, and then the continued ascent of the plunger forces the sand bodily up out of both flasks, and we have the strongest shape possible of a snap mold held by binders—a cylindrical one.

So complicated and so varied are the demands upon the foundry molding machines, that, unattractive as the hot, dusty foundry is to engineers, I suggest that today there is no more promising realm of thought to attract the genius of the machine designer who has had the opportunity to learn by hard experience what a molding machine can, and what it absolutely cannot do.

A METHOD OF MOLDING A WEB PULLEY

Elementary Practice for the Apprentice Which Possesses Many Features of Interest for the Journeyman

BY W. W. McCARTER

ALTHOUGH generally considered a simple job, the method of molding the web pulley, as shown in the accompanying illustrations, possesses many interesting features. Fig. 1 shows a vertical section of a ring pattern resting upon a core plate in which a disc of wood containing a hub and core print is shown resting upon three blocks; a plan and side view of the disc as well as one of the blocks is shown in Fig. 2; Fig. 3 is a vertical section of two dry sand cores, the boxes and cores for the hub and web being also shown; Fig. 4 is vertical section of the pulley contained in the cheek showing the cope and drag in broken section; an end and side view of the casting is shown in Fig. 5, and a cross section of the flask showing the pulley ring in position upon three wedges as well as a sweep are shown in Fig. 6.

Dry Sand Cores.

The first molding operation is the making of the dry sand cores from the inside of the ring. The diameter of the cores is governed by the inside diameter of the ring pattern and the length by the metal thickness of the web and the depth of the ring pattern. In Fig. 2 is shown one of the blocks C, the dotted

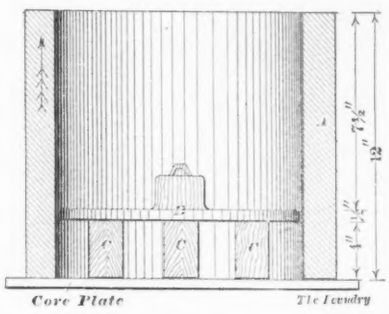


FIG. 1—VERTICAL SECTION OF RING PATTERN

lines indicating the different lengths used for making the varying widths of pulley faces.

In Fig. 1 is shown the ring pattern A resting upon a plate, with the draft in the direction of the heavy arrow. The plate may be a follow board, straight bottom board or a core plate. The disc B, with the hub and core print in place, rests upon three blocks C, which likewise rest upon the plate. Assuming that the pulley is to have a 16-inch face and that the metal thickness of the web is to be 1 inch; that the ring pattern is 12 inches deep and the disc ½ inch thick, we provide three blocks C, 4 inches long, which are set upon the plate on which the ring A rests. The disc B is placed inside of the ring and rests upon the blocks. One of the cores is then rammed up from a dry sand mixture which can be made up of one part of core compound to 14 parts of sharp sand and two parts of new sand, although the time-honored mixture of resin and flour will also give good results. The core should be vented with a large vent wire, and after the parting sand has been thrown over the top of the core, a core plate is clamped on and the core is rolled over. The blocks and the disc are removed and the ring A is withdrawn leaving one-half of the core upon the plate. The other half is then rammed up in a similar manner and contains the gate which is set upon the hub. The cores are dried and should remain in the oven a sufficient length of time to render them safe for handling. To ascertain whether the cores have been sufficiently baked a small wire should be introduced in the large vent holes and if any moisture forms on the wire, the core is too green for use. The vents are provided to permit the free escape of steam and gases during the casting operation, and if the cores are not properly vented a defective casting will result.

Small Cores.

The smaller cores are then made from a batch of sand whose binding quality is stronger than that used for the large cores. It is advisable to rod the hub core J, when its length exceeds 6 or 7 inches and its diameter is less than 1⅛ inches. The web cores I do not require rods, but a chaplet may be rammed up in the core as shown. If the web is to be made solid the four web cores are left out, the top core K being supported

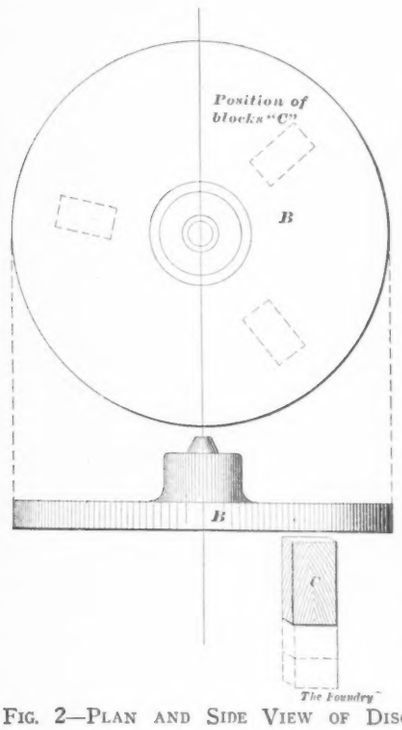


FIG. 2—PLAN AND SIDE VIEW OF DISC

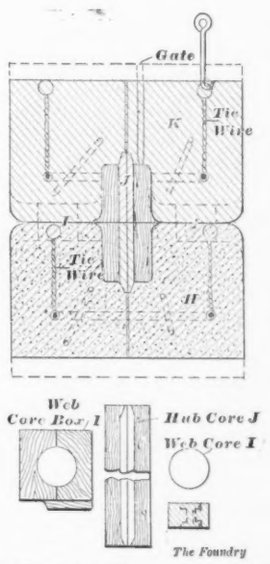


FIG. 3—VERTICAL SECTION OF MAIN CORES AND CORE BOXES FOR HUB AND WEB

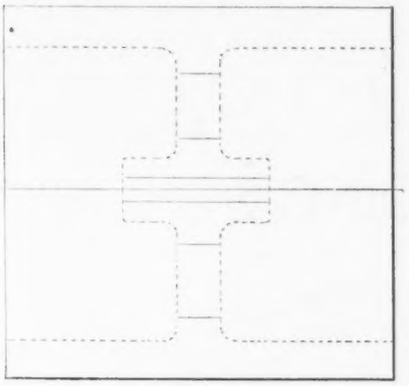
by chaplets which are set upon the lower core H, as though they were cores.

Molding the Pulley.

The operation of molding the pulley is very simple, the casting may be made in a two or three-part flask. Fig. 4 shows the bottom joint line in either case. There are many other methods of molding pulleys and the one described is confined more especially to the jobbing shops, which, as a rule, do not care to install standard pulley molding machines on account of the sharp competition met with in that specialty.

The floor line shown at the left, Fig. 4, in which a stake is outlined, indicates that the pulley may be bedded down upon the floor.

The floor line on the right shows that the pulley may be made in a regular three-part flask. The principle in either case is the same while the operations may vary in some respects. The drag may be rammed up on a follow board, rolled over and the ring pattern set upon the joint, while in bedding down, the operation is different.



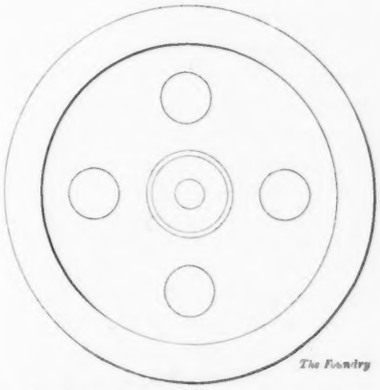


FIG. 5—SECTIONS OF THE PULLEY CASTING

In bedding down the ring pattern three wedges are placed under it, thereby suspending the ring above the bed, and the ring may be placed upon the wedges which may rest upon the floor regardless of a bed. This is done for the purpose of providing space in which the fingers may enter underneath the pattern in the operation of tucking in the sand. The pattern may be bedded in the drag in the same manner.

Making the Cheek.

The depth of the cheek should correspond to the width of the face of the pulley to be made. It is sometimes necessary to strip up a cheek to accomplish this. Almost all iron flasks have an internal angular strip, or rib, at the bottom, and when using wooden flasks, nails are generally substituted.

If impracticable to strip up an iron cheek, one deeper than the width of the face of the pulley may be used. Where this is done it becomes necessary to make the joint in the drag as shown at D, Fig. 6, or a shallow cheek may be used by bedding the ring in the drag as indicated by the dotted lines E. If the ring is bedded in the drag and a shallow cheek is used, the bottom joint line remains unchanged. The wedges, upon which the ring rests, are removed and the places they occupied are tucked under.

The sweep G is used to strike out the bottom area upon which the lower core H is to rest. In this operation the sweep G can be used to advantage on the inside of the ring only. The bottom joint is then made to the periphery of the ring, the cheek is put on and the process of ramming is begun; facing is tucked to the pattern, after which, it is rammed up to a point near the top, as shown in Fig. 6. When ramming, care should be exercised, the heaviest ramming being done nearest the side of the cheek at the bottom with the pean of the floor rammer.

The pattern is rapped on the inside, after which A is drawn up, about 2 inches at each draw until it comes flush

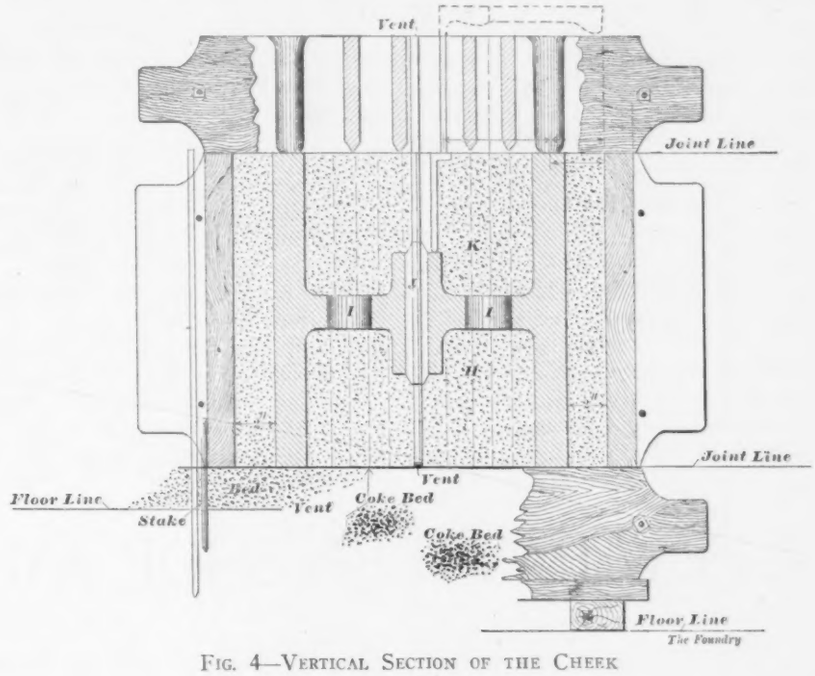


FIG. 4—VERTICAL SECTION OF THE CHEEK

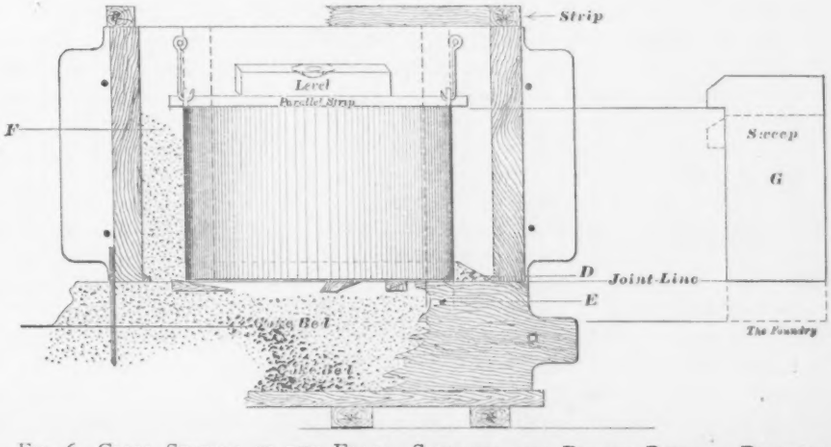


FIG. 6—CROSS SECTION OF THE FLASK SHOWING THE PULLEY RING IN POSITION UPON THE WEDGES. SWEEP G IS ALSO SHOWN

with the top joint of the cheek, here the top joint is made, after which the ring is rapped again and withdrawn.

The cope is rammed up on a follow board, measurements for the gate and risers being taken as indicated by the arrow at the top joint line, Fig. 4. Flour is dusted on the interior of the cheek, which is then lifted off and the area upon which the core H is to rest is thoroughly vented with the large wire, striking its point on the coke bed. The flour dusted on the interior of the cheek serves to reflect light into both the cheek and the drag while the mold is open.

Setting the Cores.

The lower core H is set, equally distributing the metal thickness indicated by the heavy dotted line E, Fig. 6. The four-web cores I are placed at equal distances from the hub and each other. A small roll of dough is laid on each. The hub core J is set and the upper half K of the main core is swung up by the hooks in the tie wires and is carefully lowered to its place, resting upon the four web cores I, or the chaplets previously referred to, which govern the thickness of the metal in the web. The vertical section of the two main cores, Fig. 3, clearly shows how they are handled. The method of ascertaining the length of the hub core J is also clearly shown, as its length is twice the distance from the center line, plus the thickness of the web. The cheek is finished by brushing plumbago on its surface and is guided into place.

Arrangement of the Runner.

The cope is closed and the mold is made ready to receive the metal. The runner may be cut between the bars, as shown by the dotted lines, Fig. 4, extending to the side of the cope. If the mold is to be poured with a hand bull ladle, or, with two hand bull ladles the runner may extend in both directions between the bars if the cope is 6 or 8 inches in depth. If a drag is used, the mold may be clamped. If not, the mold may be clamped and weights should be set upon the cope, being supported upon irons which get a bearing on the flask, or the mold may be weighted sufficiently that no clamps are necessary.

The short runner indicated by the dotted lines in Fig. 4 may be used when the mold is clamped. When weighted down it is necessary to use the long runner referred to, that the top of the flask may be used for the weights, the metal entering the mold through the long runner which extends to the pouring gate under the weights.

The Pound.

The back of the runner is called a pound. This is the proper place to pour the metal to avoid making scrap on top of the flask. Its purpose is to insure a steady flow of metal into the mold. It is always cut deeper than the channel leading from it. In pouring the mold it is always advisable to keep the pound full, otherwise sucking, which sometimes causes a burn down, will result.

A FEW PATTERN SHOP SANDING SCHEMES

Use of the Turning Lathe as a Sander—Sanding Gear Teeth and Curved Surfaces—Fastening the Paper

BY H. N. TUTTLE

THE GREAT advantage of the use of sanding machines for finishing patterns lies chiefly in the fact that the stock may be removed regardless of the grain of the wood. The sander does not tear up or "eat" into the grain, which is perhaps due to the extremely small amount of material removed by each separate cutter or grain of sand. Because there is but little repetition work in the pattern shop, the elaborate sanding machines so valuable in other branches of wood work are not profitable in this department, the disc sander, with perhaps a steel roll attachment, being about the only sanding machines that will prove economical. However, there are instances constantly arising where a simple sander is required, and generally, one may be quickly made of the turning lathe, whenever the disc machine will not answer the purpose.

Core Boxes.

Among other things, core boxes ranging from 1½ inches up to several inches in diameter, may be made on the lathe sander when once fitted for it—probably quicker than any other way. Not by the method of using a roll having the diameter of the required box when covered with paper, which is both uncertain and somewhat dangerous, but by a method of using guides which permit of the use of any sized roll less than the diameter of the box and which makes a box perfect in every respect.

There are first required two forms, half round, Fig. 1, about 1¼ inches thick, which should be turned together in the lathe, like any split core box, of a diameter equal to that of the required box, minus twice the depth of cut of the sand paper to be used, which should be No. 1 or 1½.

FIG. 1

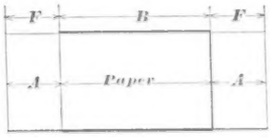


FIG. 2

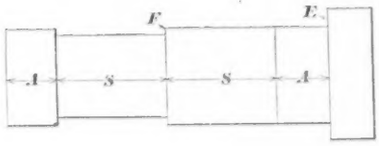


FIG. 3

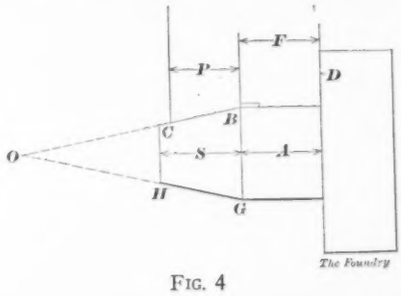


FIG. 4

These forms should be bradded on opposite ends of half the box, which should be roughly cut out to within ⅛-inch of the finish line on the band or circular saw. The roll is next prepared, which should be somewhat smaller than the box and as long or longer than the box plus the forms. Upon this roll the sand paper is fastened, extending for a distance about ¼ inch longer than the box. In Fig. 2, B equals length of box, and FF the forms. The roll being run at a high velocity, the box is held firmly up against the paper until the surplus stock is cut away so that the forms strike the bare surfaces AA of the roll, which prevents further cutting.

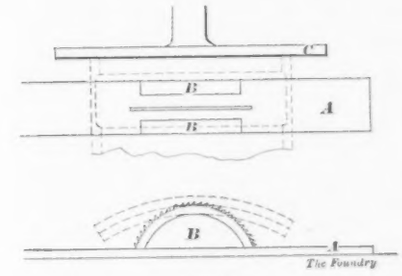


FIG. 7

The box is rotated slowly, giving at the same time a slight endwise motion until no more material can be removed, when the half box is finished. The forms are then transferred to the other half which is finished in like manner.

Turning the Forms.

Turning the forms small enough to allow the sand paper to be fastened on the level of the roll instead of being recessed in, as is usually done, not only saves the trouble of making the recess, but also permits the use of the same roll for any length of box.

As the paper is made somewhat longer than the box, it will cut into the forms a short distance, but this will do no harm, as there will still be sufficient bearing left, while this insures a clean, straight cut the entire length of the box. These forms may be used any number of times for all boxes of the same diameter, by putting sand paper of the proper length upon the roll. If a set of these forms is turned, embracing all the sizes most commonly used in the shop, the making of a straight round core box will become very simple.

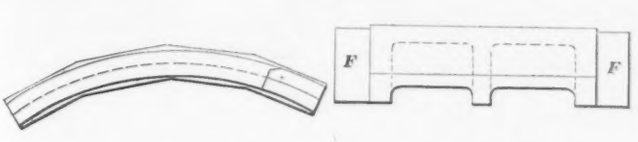


FIG. 5

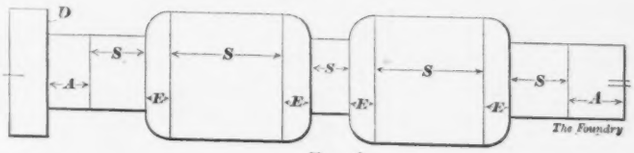
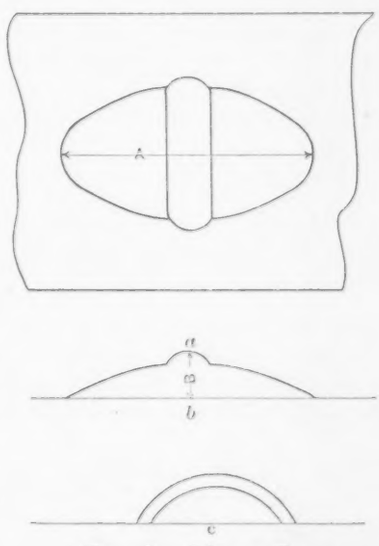


FIG. 6

Boxes With Two or More Diameters.

Boxes which have two or more diameters may be sanded by means of a special roll shown in Fig. 3. The parts SS are covered with paper, while the diameters of the bearing surfaces AA are made alike, so that only the one set of forms will be required. A shoulder is turned at E to guide the box and to locate F correctly.

For sanding the taper prints for the boxes which should be put on with the grain running at right angles to the axis of the box, a roll similar to Fig. 4 may be used. The bearing surface shown at A should be equal to the thickness of the form F. S is the paper, while P is the print which is being sanded. D shows the shoulder against which the form F is held. It will be seen that the same form used for making the straight part of the box will answer for making the print. It should be fastened with the same side to the work in both cases, that the wear caused by the edge of the paper shown at B will be on the same side of the form. If the sides BC and HG are extended until they intersect at O, the distance OC and OB will be the proper radii for laying out the form of sand paper which will just fit this tapered portion of the roll. The paper may be easily cut with the dividers.



FIGS. 9-a, 9-b AND 9-c

Sanding Curved Bottoms.

The curved bottoms of boiler brackets and patterns of a similar shape may be sanded by fastening at each end a form similar to the end view of the bracket, both the inside and the outside curve being finished on the roll. Fig. 5 shows a bracket base

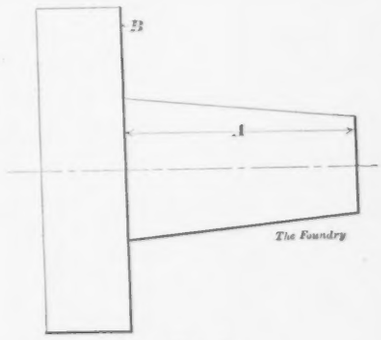


FIG. 8

with two grooves cut out of the under side to set over some obstruction on the boiler. FF represent the forms fastened on the ends of the bracket, which is shown staved up before any stock has been removed. The dotted lines show the grooves. The upper side, of course, was finished with a straight roll, but for the under side the roll shown in Fig. 6 was used. The spaces marked S were covered with sand paper.

As it would be difficult to make the paper conform to the round corners shown at EEE, these surfaces were covered with thick glue and rolled in coarse emery. AA show the bearing surfaces for the forms to run upon, and D the shoulder guide. The grooves being 5 or 6 inches wide and about 5/16-inch deep, it was necessary to rough out a good deal of this stock before sanding. This was done on the circular saw, the type shown

in Fig. 7 having been used. At A is shown a board fastened on the saw table through which the saw was run. BB are two blocks fastened to this board, whose peripheries are concentric with that of the saw, and whose radii are that of the saw minus the depth of cut. The bracket, shown in dotted lines, is guided by the fence C. It

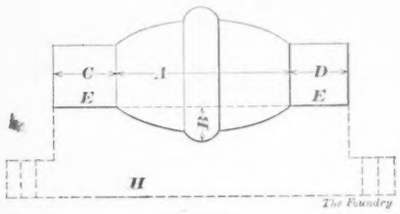


FIG. 10

will be seen that in this case the style of the form shown is much better than one which conforms to the shape of the bottom of the bracket which is usually made for this class of work, as the work would strike the table before the cut was completed.

Sanding Inside Curved Surfaces.

When sanding inside curves of such flat pieces as require draft upon the sanded surface, a special roll may be made similar to Fig. 8. The surface A, which is turned to the proper taper, is covered with paper. The shoulder B, which is turned at right angles with the axis, may be used as a guide, so that if the work is held against it while sanding, the finished surface will have the desired draft.

The following is a rather interesting instance of a stamping die pattern that was almost entirely finished by the lathe sanding method. Fig. 9, a-b-c, shows three views of what might be called a "dent" which was required to be stamped in the center of a piece of sheet metal. Several thousand of these were to be made. In making the patterns for the stamp and die, a roll was turned up, so that the dimensions, A, Fig. 10, equaled A, Fig. 9-a, and B equaled B, Fig. 9-b, and of the proper diameter to give the desired shape. The surface A, Fig. 10, was covered with thick glue for a distance of about two-thirds its circumference and rolled in coarse emery, leaving about one-third and the necks C and D bare. After the glue was hard, the roll was returned to the lathe. The die pattern, shown in dotted lines in Fig. 10, was held in the proper position, the roll cutting into it until stopped by the meeting of the bare surfaces at EE. The surfaces C and D, as well as the bare third of A were well oiled so as not to be burned during the cutting process. A rough hole was gouged out of the die H before beginning the sanding to assist in locating it properly against the roll, and the pattern was not finished to exact dimensions on the outside until after the sanding, that any slight variation in the location of the dent might be easily corrected. The die having been ground out, the roll was taken to the rip saw and the section B cut off the side which had no emery upon it. This was bradded to the bottom of the stamp. The clearance caused by the coating of emery on the roll gave the requisite allowance for the thickness of sheet steel between the die and stamp.

Sanding Gear Teeth.

When making large gear teeth of hard wood it is almost impossible to plane the bottoms with a sole plane so as to be perfectly true and out of wind. They may be very easily and quickly sanded to a perfect surface by the simple rig shown in Fig. 11. A wooden face plate perhaps 1½ inches thick and of a diameter somewhat less than that of the gear rim is

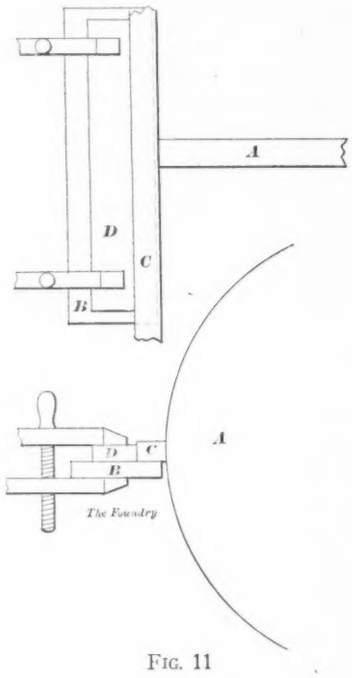


FIG. 11

shown at A, that the teeth will bear rather more upon the edges than at the center. Almost any old wooden face plate of about the right size will do, the outside edge being trued and a strip of garnet paper fastened around the edge. The foundation board B is clamped and braced rigidly in the position shown. The teeth are made in strips about three or four feet long, shown at C and are made straight, true and of the same size. The guide D is held by a couple of hand screws. The strips are all pushed through, taking off a cut of from 1-32-inch to 1-16-inch. The guide is then tapped forward a trifle and a light finishing cut taken. The guide should not be quite parallel to

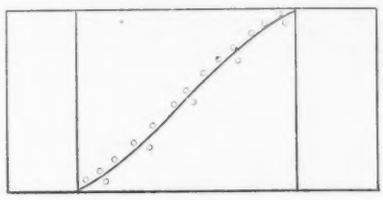


FIG. 12

the cutting surface of the wheel but slightly at an angle so that the work will enter nicely and not put all of the work on the inside edge of the paper. If the gear is small enough that the teeth may be hollowed out over the circular saw there is no other way as rapid, but for the larger gear and especially if the teeth are made of cherry or mahogany, there is probably no other way as fast nor as good.

Threshing machine concaves, which are usually made of hard wood and consist of a large number of short pieces and which are therefore especially hard to plane nicely, may be sanded on a rig similar to this one.

The sanding of the faces of gear teeth, both spur and bevel, has been very well described in this magazine, and it is probably in this work that the lathe sanding roll is most valuable.

Fastening the Paper.

There are several ways of fastening the paper upon the rolls. The factory-made machines are generally equipped with an eccentric clamp, a split roll or some such convenient device, but where all sorts of sizes and lengths are required, and these only for short jobs, it hardly pays to equip a shop with them. Many patternmakers glue the paper on. This makes a neat job and would probably be the best way, were it not that the paper wears out quite rapidly. This prohibits this method for long jobs which require several changes of paper.

Another way is to cut a groove in the roll and clamp the paper with a wooden key. The disadvantage of this is that the jump over the key gives a vibration which is very disagreeable and often prevents good work. The most convenient method

the writer has ever used is that of nailing the paper on with cigar box nails. The flat heads hold the paper nicely and yet are small enough to sink into the wood sufficiently deep to be out of the way when cutting. They may be easily lifted out for changing the paper. The joint on the paper should not be square across, but should run diagonally around the roll as shown in Fig. 12. When put on this way there is little chance of the paper being torn off and the motion is perfectly uniform. The joint advancing gradually across the work does not affect it at all. Only the advancing side of the paper need be thoroughly nailed. About one brad in 5/8-inch on the advancing side and one in 2 inches on the following side is sufficient. As these brads are to be removed, the roll should be made of pine instead of hardwood. A hole should be bored in either end of the roll and a hardwood dowel glued in for a bearing for the lathe centers.

It might seem that a pine roll would soon wear away, but by occasionally touching a piece of beeswax where the bearing comes, the roll will not wear. One roll, upon which perhaps 2,000 cherry gear teeth, averaging 2-inch pitch and 4-inch face have been sanded, has not shown the slightest wear. The point of greatest wear is at the dead-center, which should be frequently waxed, beeswax not burning out as easily as oil, and the lathe stopped between the sanding of each tool to allow it to cool off. If the lathe can be connected with the exhaust pipes without too much trouble it should be done, as sanding operations on this machine are pretty disagreeable if some contrivance is not used to take care of the dust.

ORGANIZATION OF THE PATTERN SHOP

Division of the Working Force to Secure the Best Results—Arrangement of the Machinery

BY OSCAR E. PERRIGO

AS GENERALLY conducted, the pattern shop presents a fertile field for the factory organizer. Although operations in every department of the average manufacturing plant have been carefully systematized, the pattern shop has received little attention. This department is considered by many manufacturers as one of the necessary evils that must be endured, and the men engaged in pattern work are often looked upon as non-producers, because they make nothing that may be boxed up, shipped to market and sold for money. The fact that but for the patterns they turn out, the product that is sold would not be possible, is overlooked, or its importance considerably minimized.

While the patterns may not, in usual business practice be sold outright, yet in a large majority of cases they form a most valuable asset which would, as years go by, be very difficult and expensive to replace and which with good reason, the provident manufacturer keeps well protected by ample insurance.

Early Methods.

In former years it was not unusual to find the pattern shop located in parts of the plant not adapted to this class of work. Sometimes a corner in the machine shop was set apart, with neither wall nor partition to protect it from dust and dirt; again, on a floor over the iron foundry, or in a more or less temporarily constructed building adjoining it. It was invariably inadequately equipped with poorly designed and obsolete machinery. The benches were better adapted to carpenter work than patternmaking, and the supply of trestles, layout and work tables, clamps and similar facilities were of a primitive nature. The lumber was in keeping with the general surroundings, usually of such poor quality that the production of good patterns was quite impossible, and of such awkward forms and sizes that much time was lost in getting it into useful and workable condition.

Fortunately, many of these conditions have been changed. Well designed and constructed buildings are now provided for this work. The buildings are properly lighted, heated and ventilated. They are equipped with an abundance of well built machinery of the latest and best design. Lumber especially cut and prepared for patternmaking is purchased and an ample supply kept on hand for use so that it may become thoroughly seasoned, even after being received at the works, thus guarding against any neglect that it might have previously suffered.

As a result of these changed conditions the patternmaker of today is able to turn out, not only a greater amount of work than formerly, but the quality shows a great improvement over that of former years. While these improvements have been taking place little attention has been given to the systematic organization of this department.

Ancient Equipment.

As the pattern shop was formerly conducted the patternmaker was furnished his lumber "in the rough," and his first duty was to cut it up to the required dimensions and plane it. For this work he was provided with cross cut, circular and jig saws (not the modern band saw).

In some shops a single surfacing planer was provided, but usually the only equipment in addition to the saws mentioned was a lathe, and it was not unusual for the patternmaker to prepare his piece of work for turning and take that under one arm and his box of tools under the other and go to the machine shop, and in a greasy speed lathe attempt to do a clean, accurate and respectable looking piece of pattern turning.

In any case, much of his time was used in the preparation of his material; in sawing pieces to dimension; in sawing out segments and building up circular work; in surfacing and gluing up large pieces; and as the pattern was nearing completion, in sand-papering, varnishing, rubbing down and finishing the pattern.

By this method the expert patternmaker did a great deal of preparatory and final work that could have been as well and frequently better done by a man employed at considerably lower wages. There is no disposition in this article to favor the employment of what are usually called "cheap men," but rather to point out the different classes of work to be carried

on in the pattern shop and to assign the best and most economical man for each class.

Cheapness, as the word is generally understood, is not economy. False ideas in this respect usually result in the expenditure of more money than if the policy of seeking for the best were adopted.

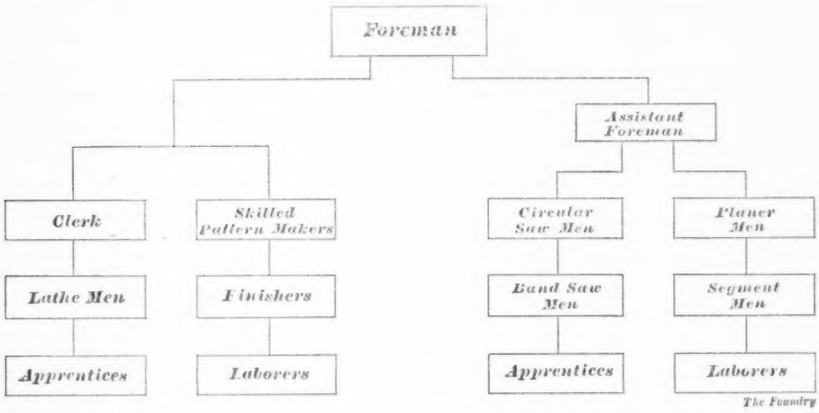


FIG. 1—CHART SHOWING THE ORGANIZATION OF THE PATTERN SHOP FORCE

Operations Systematized.

By classifying the different steps of the pattern shop in the same manner that we handle factory operations we can obtain many advantages in efficiency and economy in the management of the shop.

These operations may be divided as follows:

First—Providing the lumber, transporting it from the yard, store house or the drying room.

Second—Cutting up the lumber as required by the patternmakers.

Third—Planing the lumber, usually on four sides in the single and double surfacers and buzz planers or jointers.

Fourth—Shaping and building up the planed lumber into such sections as do not require a skilled patternmaker, such as cutting segments and gluing them into blanks ready for turning; gluing large masses for turning; band sawing or shaping by hand, etc.

Fifth—Turning, face plate work, chuck work, and work held on centers.

Sixth—Patternmaking, the necessary work of skilled patternmakers.

Seventh — Finishing, including the fitting of draw plates, sand-papering, varnishing, rubbing down, attaching pattern letters and figures, marking, etc.

Eighth—Recording and storing patterns, making the proper book or card records of the patterns and the loose parts belonging to them, and locating them in their assigned places in the pattern storage.

Having satisfactorily classified the work to be performed, we may the more readily classify the workers engaged in performing the various operations.

Classification of the Operators.

The force suitable for a shop of 30 employes and over should consist of a foreman, assistant foreman, clerk (who may be one of the apprentices), a number of skilled patternmakers, a number of men frequently called mill men for operating circular saws, band saws, planers, etc., apprentices, and one or more laborers.

The system of organizing the force will be readily seen by reference to the chart shown in Fig. 1. The plan in brief is, for the assistant foreman to have charge of the men who provide the lumber and prepare it for the work of the skilled patternmakers, therefore they are the mill men doing the same work as in a mill, getting out dimension lumber for building purposes. The assistant foreman should be a practical patternmaker as it will be necessary for him to properly understand how the lumber is to be used in order to select that which is most suitable for each particular job. Each of the apprentices should serve a part of his time at this work at the commencement of his term. There will be laborers for handling lumber and dimensioned material.

The foreman will have a general oversight over the assistant foreman's force, and will devote his attention particularly to working up the lumber provided by the mill men, and therefore will have under his personal charge, the clerk, skilled patternmakers, lathe men, finishers, the advanced apprentices and one or more laborers for handling and storing patterns.

Division of Work.

In Fig. 2 is given a table showing the number of men of each class and the total number in the force of from seven to 50 men. It will be seen that for as small a force as seven to 10 men there are but two mill men, the duties of five men in the larger organization being divided between them. For forces of 15 to 20 men there are three mill men, similarly dividing the work.

In forces of seven to 10 men the foreman is expected to work as a skilled patternmaker, but it will be necessary in distributing the work to reserve such for himself as can be carried along jointly with his duties as foreman. Therefore he will not take up the work of making large and

FOR A TOTAL FORCE OF	7	10	15	20	30	40	50
Foreman	1	1	1	1	1	1	1
Assistant Foreman	—	—	—	—	1	1	1
Clerk	—	—	—	1	1	1	1
Skilled Pattern Makers	2	4	7	10	14	20	28
Lathe Men	1	1	1	1	2	2	3
Segment Men			1	1	1	1	1
Band Saw Men					1	2	2
Circular Saw Men	1	1	1	1	1	2	2
Planer Men					1	1	1
Finishers	1	1	1	1	2	2	2
Apprentices	1	1	2	3	4	5	6
Laborers	—	1	1	1	1	2	2

The Foundry

FIG. 2—CLASSIFICATION AND DIVISION OF THE FORCE

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

STANDARD SPECIFICATIONS FOR STEEL CASTINGS.*

Process of Manufacture.

1. Steel for castings may be made by the open-hearth, crucible or Bessemer process. Castings to be annealed unless otherwise specified.

Chemical Properties.

2. Ordinary castings, those in which no physical requirements are specified, shall not contain over 0.40 per cent of carbon, nor over 0.08 per cent of phosphorus.

3. Castings which are subjected to physical test shall not contain over 0.05 per cent of phosphorus, nor over 0.05 per cent of sulphur.

Tensile Tests.

4. Tested castings shall be of three classes: "Hard," "Medium," and "Soft." The minimum physical qualities required in each class shall be as follows:

	Hard castings.	Medium castings.	Soft castings.
Tensile strength, pounds per square inch.....	85,000	70,000	60,000
Yield point, pounds per square inch.....	38,250	31,500	27,000
Elongation, per cent in two inches.....	15	18	22
Contraction of area, per cent.....	20	25	30

Drop Test.

5. A test to destruction may be substituted for the tensile test in the case of small or unimportant castings, by selecting three castings from a lot. This test shall show the material to be ductile and free from injurious defects, and suitable for the purposes intended. A lot shall consist of all castings from the same melt or blow, annealed in the same furnace charge.

Percussive Test.

6. Large castings are to be suspended and hammered all over. No cracks, flaws, defects nor weakness shall appear after such treatment.

Bending Test.

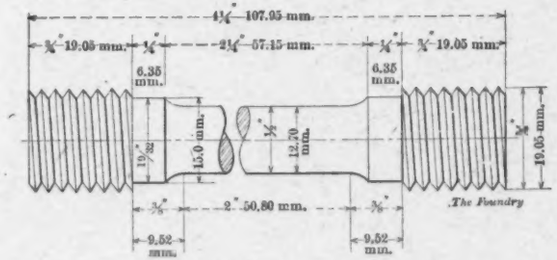
7. A specimen one inch by one-half inch (1″ x ½″) shall bend cold around a diameter of one inch (1″) without fracture on outside of bent portion, through an angle of 120° for "Soft" castings, of 90° for "Medium" castings.

Test Piece for Tensile Test.

8. The standard turned test specimen, one-half inch (½″) in diameter and two inch (2″) gaged length, shall be used to determine the physical properties specified in paragraph No. 4. It is shown in the following sketch:

*Adopted by the American Society for Testing Materials.

Standard Specifications for Steel Castings.
(Continued from Data Sheet No. 11.)



Number and Location of Specimens.

9. The number of standard test specimens shall depend upon the character and importance of the castings. A test piece shall be cut cold from a coupon to be molded and cast on some portion of one or more castings from each melt or blow or from the sink-heads (in case heads of sufficient size are used). The coupon or sink-head must receive the same treatment as the casting or castings, before the specimen is cut out, and before the coupon or sink-head is removed from the casting.

Test Piece for Bending.

10. One specimen for bending test one inch by one-half inch (1″ x ½″) shall be cut cold from the coupon or sink-head of the casting or castings as specified in paragraph No. 9. The bending test may be made by pressure, or by blows.

Yield Point.

11. The yield point specified in paragraph No. 4 shall be determined by the careful observation of the drop of the beam or halt in the gage of the testing machine.

Sample for Chemical Analysis.

12. Turnings from the tensile specimen, drillings from the bending specimen, or drillings from the small test ingot, if preferred by the inspector, shall be used to determine whether or not the steel is within the limits in phosphorus and sulphur specified in paragraphs Nos. 2 and 3.

Finish.

13. Castings shall be true to pattern, free from blemishes, flaws or shrinkage cracks. Bearing surfaces shall be solid, and no porosity shall be allowed in positions where the resistance and value of the casting for the purpose intended, will be seriously affected thereby.

Inspection.

14. The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of manufacture, prior to shipment.

complicated patterns. In a force of 15 men working on the usual run of work the foreman may do some patternmaking, but he will have to confine his work to short and simple jobs or some repair work, otherwise his duties as foreman will be more or less neglected.

The clerk may be one of the apprentices, but it will be better to employ a permanent man for this work as he will have charge of pattern records and various accounts, the accuracy of which would suffer if kept by various persons from time to time.

Apprentices.

There may be employed to advantage one apprentice to each of the eight men in the total force. They should begin their apprenticeship with the "mill men" and be passed along through the different grades and classes of work at the machines and at the bench, under the instruction of good workmen, including the foreman and his assistant.

The classification and the distribution of men for the various steps are arranged for an average class of work. In shops where most of the work is small and requires great accuracy, the proportion of skilled patternmakers would probably be doubled. On the contrary, if most of the work consisted of large and heavy patterns the proportions would be reversed.

The mill men, while not patternmakers, should have a fairly good conception of the trade of patternmaking and certainly of the vast difference between it and carpenter work. Otherwise they are liable to make costly mistakes in the preparation of lumber.

The men here denominated as segment men should be expert in this particular class of work. Such a man will turn out about twice the amount of work that the ordinary patternmaker will produce, while his rate of pay will be considerably lower. He can also be employed on many other jobs such as gluing up stock for the lathe men and similar work.

While there is more than one lathe man the second man can be profitably employed in keeping up a good supply of core prints, bosses, etc., when work on his special jobs is slack. The lathe men, being employed continually on one class of work, will be found quite as accurate as skilled patternmakers and much more economical.

The work should be classified and specialized as much as possible. Skilled workmen should be kept on such work as requires their particular qualifications, and all work or operations on a job that may be done by less skilful men, or apprentices should be assigned to them.

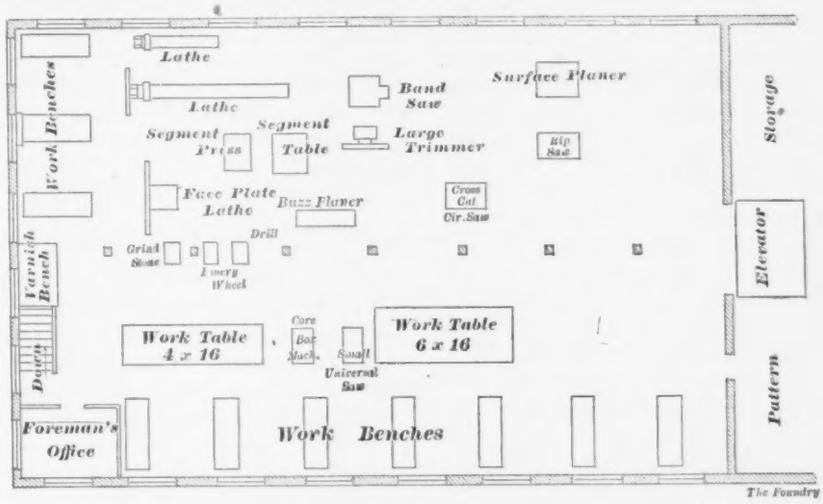


FIG. 3—ARRANGEMENT OF THE PATTERN SHOP FOR A FORCE OF 15 MEN

When patterns are ready to have the lifting plates fitted, and to be sand-papered, varnished, rubbed down, etc., the skilled patternmaker should pass them along to a man getting from one-half to two-thirds as much pay, but who will do the work quite as well, and from making this class of work a specialty will do it economically.

It will be found in practice that a systematic plan and organization along these lines, modified to suit local conditions, will do much for the discipline and efficiency of the force and will result in great economies in production.

Layout of Small Plant.

To fully carry out this plan of organization the arrangement and equipment of the shop must be such that it can be handled successfully by the system described. In Fig. 3 is shown the plan of a shop arranged for the employment of 15 men, with the proper equipment for such a force, and arranged to be operated as shown. Its dimensions are 50 by 80 feet. The lumber is received on an elevator, the planers and circular saws being conveniently located so as to save unnecessary handling. The machines are grouped so that the lumber passes along through progressive operations to the hands of the skilled patternmakers. A considerable area of clear floor space is left around the planers

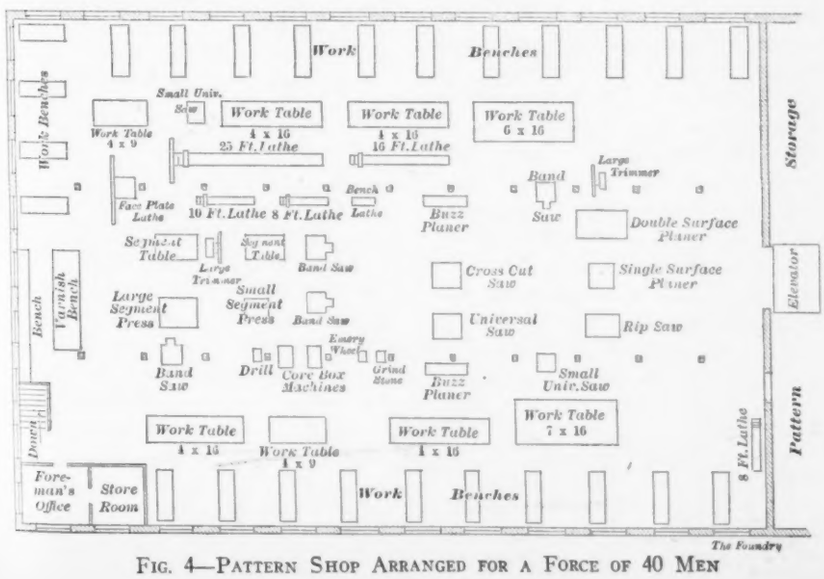


FIG. 4—PATTERN SHOP ARRANGED FOR A FORCE OF 40 MEN

and between them and the elevator for taking in and handling lumber. On the opposite side a similar space is reserved for the building up of large patterns, which will be more conveniently handled near the elevator.

The work benches are placed with their head ends toward the light. Work tables of various sizes are provided. A small universal saw table is located conveniently to the line of benches and is for the use of the patternmakers rather than the "mill men." It will be useful to them on a large portion of their regular work. A core box machine is similarly located, being closely related to the patternmaker's regular work. The varnish table is at a distance from both the benches and the machines, for obvious reasons. Work composed of segments is rapidly built up by the use of the segment press, band saw, and trimmer, which are located near each other. A grindstone is provided, as many patternmakers are averse to grinding their tools on emery wheels.

Even in this small shop there should be at least one cast iron surface plate of such dimensions as the work may render necessary, preferably not less than 36 x 48 inches. There should be one bench trimmer to every four patternmakers, in addition to the one used by the segment men.

The foreman's office should contain a desk, a drawing table and proper facilities for storing small patternmakers' supplies.

Arrangement of Large Shop.

In Fig. 4 is shown the plan of a pattern shop arranged and equipped to accommodate a force of 40 men, classified as shown in the table given in Fig. 2.

The general arrangement is similar to the plan shown in Fig. 3. The shop is 80 by 120 feet. In addition to the foreman's office equipped with a desk and a drawing table for the foreman and a desk for the clerk, there is a small store room for patternmakers' supplies, which, for a shop of the dimensions shown, will require considerable space.

In this case two small universal saw tables are provided for the special use of the patternmakers located in the opposite corners of the room. A lathe is also provided for the use of those working at the benches more remote from the group of lathes. This section is also provided with a buzz planer. This arrangement avoids the necessity of the patternmaker "traveling all over the shop" to reach the machine he may be compelled to use but a few minutes.

The floor space allotted per man in these two plans is 226 square feet in the small shop and 240 square feet in the larger one. This will be about the average, including the space occupied by machinery, lumber, etc. If the patterns to be made are comparatively small this amount of floor space may be reduced to 200 square feet per man, while if very large patterns are made 300 square feet or more will be necessary.

BLOW HOLES AND GASES IN CAST IRON.

By G. B. Waterhouse

At the Toronto meeting of the American Institute of Mining Engineers, E. Von Maltitz read a paper on "Blow Holes in Steel Ingots." Under one heading he referred to cast iron. When the metal contains at least 2.3 per cent carbon, and various amounts of other impurities such as manganese, silicon, phosphorus and sulphur, it is classed as pig iron. It is distinguished chemically from steel by the higher percentage of these impurities, especially carbon. It is known that iron in the molten state is able to absorb gases, and to expel them again on freezing.

The amount of gases taken up by iron in the blast furnace probably depends on the pressure in the hearth of the furnace, the degree of superheating in the hearth, the percentage of silicon in the metal, the melting point of the iron and the slag, and the percentage of moisture in the blast.

The more gases the iron is able to absorb while in the blast furnace, the more it will try to set free when solidifying, so far as its degree of fluidity will permit. The more fluid the metal, the more gases it will allow to escape. The thicker and more viscous the iron, the more gases will stay in it, and the greater the possibility of blow holes. These propositions are well brought out in Tables I and II, taken from Munker, *Stahl und Eisen,* Vol. 24, page 23.

Table I.

Gases, escaping from molten iron.

	Hydrogen. Per ct.	Carbon monoxide. Per ct.	Carbon dioxide. Per ct.	Oxygen. Per ct.
Foundry iron, thick and mushy	6.4	4.5	8.6	0.5
Basic iron and spiegeleisen, thin and fluid	21.9	19.1	1.3	0.4
Foundry iron, very thin and fluid....	47.3	13.7	1.3	0.5

The first analysis is the average of 13 determinations, that of the gases from basic iron and spiegeleisen the average of 48, and the last one of six.

Table II.

Gases obtained by drilling solid foundry irons.

Size of drill hole. Cubic Centimetres.	Volume of gas.	Hydrogen. Per cent.	Carbon monoxide Per cent.
61	26.2	57.6	0.7
55	16.6	42.2	1.9
61	31.6	59.0	0.9
58	47.6	66.1	0.6
48	17.0	59.0	3.5
55	32.2	46.2	1.2
53	31.2	56.7	1.3
65	74.8	43.6	0.3
55	76.6	67.3	0.2

The question arises why it is that pig iron, although absorbing in the molten state large amounts of gases, has by no means so great a tendency to form blowholes as steel or ingot iron. Blowholes in steel are due in no small part to the dissolved ferrous oxide. This combines with the carbon, added with the deoxidizing materials and liberates carbon monoxide, which in its turn causes the steel to liberate the occluded nitrogen and hydrogen.

We know that molten iron increases in solvent power for ferrous oxide, with rising temperature and an increasing degree of purity, and that on the other hand, the affinity of carbon for oxygen seems to lag behind that of iron, the higher the temperature rises.

In pig iron, the melting point of which is considerably below that of steel, the solvent power for ferrous oxide must naturally be much smaller. In approaching the freezing point, pig iron is not able to form as much carbon monoxide as steel. The solidification of pig iron is therefore accompanied by a sudden, but only a quiet liberation of absorbed gases.

The reason the gases, though less abundant than in cooling steel, do not cause the formation of blowhole rings in the solidifying iron is found in the sudden passage of pig iron from the molten to the solid state without first becoming pasty. It is the pasty steel which entangles the liberated gases in its rapidly growing network, and, because it is pasty and can therefore be pushed aside somewhat, allows the small bubbles to accumulate in large blowholes. Pig iron does not experience such a pasty stage. The liberated gases can therefore escape during the entire period of approach to the freezing point, and are not detained by any intermediate pasty material.

THE JOBBING BRASS FOUNDRY—IV

A Comprehensive Discussion of the Use of Aluminum Alloys for Castings

BY J. F. BUCHANAN

IN SOME ways aluminum is a wonderful metal, but foundrymen are chary of using it freely in alloys because of the troubles which frequently follow, such as segregation, porousness, cracks, excessive shrinkage, and the difficulty of making satisfactory combinations with some of the other metals in every-day use for castings. There is a limit to the amount which some metals will take up in alloying.

According to Dr. Richards, aluminum can hold a little over 1 per cent of lead in solution, and from personal experience with aluminum bronze (copper and aluminum mixtures), I have been forced to the conclusion that a very small percentage of lead exerts a very injurious influence on the physical properties of this alloy.

Aluminum for Alloys.

Similarly, if aluminum is to be introduced for any special purpose into ordinary gun metal, yellow brass or German silver alloys, great care must be taken to use metals entirely free from lead, otherwise unreliable castings will result. The castings as taken from the mold may appear to be all right, but when the skin is broken on the lathe, a patchy appearance, due to the segregation of the lead and the formation of oxides in the molten metal, shows up the weakness and irregularities of a bad mixture. On this account, all metals containing aluminum should be kept scrupulously apart from the ordinary alloys used in the brass foundry.

The fact is, with all our modern improvements and cheapening processes for the increased production of aluminum, we are not yet familiar with the use of the metal as a mixer, and foundrymen are still seeking for information as to the proper use of it in alloys.

Zinc and Aluminum.

Zinc has been found to be the most natural alloying metal for aluminum. Indeed, the two metals may be combined in any proportions almost as freely as the brass (copper-zinc) alloys, and with casting qualities equally as good. As a general rule, however, alloys of aluminum with another metal, binary alloys, are seldom satisfactory for castings, and many mixtures which are serviceable for rolling, hammering, or otherwise working into shape, are utterly useless for foundry purposes. Silver and aluminum, copper and aluminum, and zinc and aluminum are decidedly the best of the binary alloys for castings.

Nickel Aluminum Alloys.

Nickel aluminum alloys have poor mechanical properties and they are difficult to make. Tin-aluminum alloys are unstable and weak and magnesium-aluminum, the lightest of all the aluminum alloys, casts badly and is subject to great waste and change on remelting. Where cost is not a factor, and fine grain, color, polish and resistance to corrosion are important, the silver-aluminum alloys are by far the best for ornamental castings, statuettes, etc., from 3 to 5 per cent silver being the average proportions. Sometimes 1 per cent of copper is added to reduce the cost, or to insure better wear, as in the case of cast dental plates and fine instruments.

Imitation Silver.

Many imitation silvers and so-called Argentan alloys are now produced with aluminum as the base. The aluminum content ranges from 88 to 94 per cent and the alloying metals, copper, tin and nickel, are present in equal proportions, varying from 2 to 4 per cent. Cowles' "silver bronze" is also a substitute for German silver, but its electrical resistance is about forty times greater. Although there is no nickel in the composition, it is more closely allied to the standard German silver alloys than those having aluminum as the base. The mixture consists of manganese, 18 parts; aluminum, 1¼ parts; silicon, ¼ part; zinc, 13 parts, and copper, 67½ parts.

Aluminum Bronze.

The very first aluminum alloy to come into prominence was the now famous, but seldom used, aluminum bronze, containing copper 90 to 95 per cent, and aluminum, 5 to 10 per cent. This is an ordinary heavy bronze, with the tin replaced by aluminum. It is a superior alloy to tin bronze, having all the advantages in double the tensile strength, greater resilience, more artistic appearance and color, no segregation or hard spots, better resistance to corroding influences, and, owing to the cheapening of aluminum, the cost by weight is now slightly less. This alloy has never had a chance to distinguish itself in engineering practice. Brass founders have not treated it fairly. They still persist in varying the formula, and add zinc, tin, lead or some other ingredient to cheapen the product with the result that aluminum bronze has fallen into disrepute, and aluminum brass has been substituted for the bronze for many purposes. To those looking for a first-class bronze, giving strong homogeneous castings, no better mixture can be recommended than the following: Copper, 90 parts; aluminum, 8 parts, and phosphor copper, 2 parts.

Some modifications of this bronze are made by adding tin to the mixture, from 2 to 8 per cent, according to the degree of hardness required. A good mixture for bearings is composed of copper, 95 parts; aluminum, 5 parts, and tin, 8 parts. For a close-grained bronze suitable for machine parts and steam metals, use copper,

90 parts; phosphor copper, 2 parts; tin, 4 parts, and aluminum, 4 parts.

Gun Metal Alloys.

An improved series of gun metal alloys containing aluminum consists of copper, 84 to 88 per cent; tin, 6 to 10 per cent, and aluminum, 2 to 6 per cent. The hardest of these mixtures is suitable for bells and equal to cast steel in strength. It must always be borne in mind, however, that metal made simply by mixing aluminum and copper does not acquire its best properties till it has been remelted several times. For all of these aluminum bronze alloys it will be best to make a "hardening," of the copper and aluminum, say 50 parts of each.

Melt the copper first, and add the aluminum gradually, taking care to keep the metal in a barely molten state. This alloy is very brittle. It is an easy matter, therefore, to add any desired quantity of aluminum to the bronze. As molten aluminum alloys oxidize more rapidly than most of the regular casting metals, it is well to cover the metal with carbon, and a plumbago crucible lid kept on while the metal is melting helps to prevent drossing due to the access of air. No flux is necessary. Aluminum is an earthy metal, and anything that would flux it would act also on the crucible, to the detriment of the metal. Overheating must be avoided, and when once the metal is ready it must not be held in the fire.

With these precautions, and ordinary care not to mix metals of a different class with the aluminum bronzes, sound castings are as easily obtained as with ordinary bronze alloys. A specially tough bronze has the following composition: Copper, 87 parts; tin, 10 parts; nickel, 1½ parts; and aluminum, 1½ parts.

Aluminum Brass Alloys.

Passing to the aluminum brass alloys, we get a big range of metals with splendid casting qualities and wonderful strength and toughness. Ordinary yellow brass—copper, 70; zinc, 30 (no lead)—with 2 per cent aluminum added, is transformed to a high tension bronze. This metal may be used for almost every conceivable casting, from the lightest ornament to a ship's propeller wheel. Valves, bearings and frictional parts of machines are excepted.

Aluminum brass is the easiest of the ternary alloys to manipulate. The three metals combine well in proportions ranging as follows: copper, 56 to 80 parts; zinc, 20 to 42 parts; aluminum, one to six parts. The tenacity of the alloys varies between 40,000 pounds and 90,000 pounds per square inch.

Other metals are sometimes added with good effect, notably manganese, between 1 and 2 per cent; iron and phosphorus, about 1 per cent; tin, 1 to 3 per cent.

To the brass founder accustomed to the pouring of "high" brass, aluminum brass presents no difficulty, and this may be one of the reasons for its popularity. Due to the comparatively low specific gravity of aluminum, ordinary heavy metals in combination with it are liable to segregate when cooling down to a solid condition and further, the high specific heat, contraction and atomic volume, characteristic of the metal, make it difficult to get serviceable combinations. These are the main drawbacks to the working of the binary alloys, like the copper-aluminum bronzes already dealt with, but with the ternary alloys, such drawbacks, to a large extent, vanish. Nevertheless, each class has its own points of excellence, and whether it be the bronze or the brass that is used, the artistic as well as the useful and economic value of the alloys should be considered.

Light Alloys.

The light alloys of aluminum are more numerous and generally speaking, more applicable to the modern craze for light fittings for automobiles, motor boats, scientific apparatus and art metal castings. Classed with the light alloys are several combinations of rare metals, or metals requiring extremely high temperatures for their reduction, as chromium, tungsten, titanium, etc. These are scarcely worth the increased cost and trouble, and certainly they are not necessary for ordinary castings. Used with copper and nickel, manganese makes the hardest light alloy of aluminum yet produced.

Susini Alloys.

Susini's alloys contain from 3 to 10 per cent of alloying metals, the latter being zinc, copper, and manganese. He makes the alloy of the three latter separately, melts the required quantity of aluminum and then pours the liquid alloy into it.

The three alloys he recommends must contain in percentages:

Manganese.	Copper.	Zinc.
1 to 3	1.5	0.5
1 to 5	2.5	1.0
2 to 8	4.5	1.5

Good casting alloys for small figures and art designs may be had with tin and nickel combinations, as for example, tin, 7 parts; nickel, 3 parts; and aluminum, 90 parts. This alloy is whiter than aluminum and can be more easily soldered and polished and gives very sharp outline and detail in sand castings.

Stronger Alloys.

A stronger series are the ternary alloys of nickel, copper and aluminum, nickelumen alloys, as they are sometimes called, have great tenacity and a high elastic limit. A typical alloy in this class for rolling contains copper, 3½ per cent, and nickel 1½ per cent. For casting purposes the alloying metals may be increased up to 10 per cent with advantage, and for rigid alloys the nickel content may even be increased beyond the copper.

An excellent substitute for these nickelumen alloys is composed of aluminum, 91 parts. antimony, 1 part, and phosphor copper, 8 parts. An alloy whose specific gravity is nearly the same as pure aluminum, is composed of aluminum, 96 per cent; antimony, 2 per cent, and phosphorus, 2 per cent. These alloys are not so expensive to make as the nickelumen or magnalium alloys and they answer quite as well for many kinds of castings.

All magnalium alloys (aluminum and 1 to 10 per cent magnesium), are improved by the addition of zinc, 1 to 20 per cent, and there is better wear in the metal, which is more homogeneous. For rolling, nickel and copper take the place of zinc in some magnalium mixtures. One of these mixtures shows aluminum, 96 parts; magnesium, 2 parts; nickel, 1 part, and copper, 1 part.

Cheapest Aluminum Alloys.

After all, the cheapest and most reliable of all the aluminum alloys for castings are zinc-aluminum mixtures, with possibly small additions of copper, phosphorus or tin. These alloys are well adapted for pattern metals. They may be melted and cast by the ordinary foundry methods, without the slightest trouble. The average composition shows aluminum 80 to 90 parts; copper, 1 to 6 parts; zinc, 5 to 20 parts; phosphorus, 1 to 2 parts, and tin, 1 to 5 parts. A typical alloy in this class is aluminum, 88 parts; zinc, 10 parts, and phosphor copper, 2 parts. If tin is desired in the mixture, phosphor tin may take the place of all or part of the phosphor copper.

These alloys cast smoother and with less oxidation than most other aluminum combinations, and the zinc cheapens the product without destroying the desirable qualities.

USE OF COTHIAS METAL FOR CASTINGS

Mixtures with this Base Alloy as a Constituent—Furnaces and Permanent Molds

BY EMIL B. HORNE

THE MANUFACTURE of castings from Cothias metal, not extensively used in this country will prove profitable to many brass foundrymen. The base alloy consists of 66.7 per cent of copper and 33.3 per cent of tin, which is cast into small ingots for future use. With this base metal three different mixtures are made depending upon the strength of the castings required and the cost of the same. For small castings the following mixture is recommended: Base alloy (Cothias metal), 11.75 per cent; aluminum, 88.25 per cent.

The mixture more commonly used is made up as follows: Zinc, 70 per cent; aluminum, 15 per cent; tin, 7.50 per cent; base alloy, 7.5 per cent.

The cheapest mixture follows: Zinc, 85.6 per cent; aluminum, 0.40 per cent; tin, 7.33 per cent; base alloy, 6.67 per cent.

As far as I have been able to ascertain there are only two brass foundries producing castings from Cothias metal. The one is located in Paris, France, where the mixture originated, and the other in Leipzig, Germany. The French plant is well equipped and employs about 50 men, while the German foundry is not as large, but gives steady employment to 20 men.

Cast Iron Molds.

The molds are all made of cast iron and with ordinary care give good service for many years. The castings range in weight from a few ounces to several pounds and are produced very economically as they require no finishing except the cutting off of the gates. I have seen gears cast that were perfect in every way; levers, nuts and glands with the threads cast on and such complicated pieces as are required for trimmings for counters, cash register frames, meter cases, etc., after being taken out of the molds were ready for assembling. All of the holes for bolts were cored and required no machining.

Furnaces.

The furnaces are of the natural draft type and coke is used for fuel to insure a slow but steady source of heat to maintain a No. 90 crucible at the proper temperature. If the metal is too hot an excessive amount of dross will form as a result of the oxidation of the aluminum, while if too cold, the castings will not have the required strength and the fine lines of the mold will not come sharp. The four furnaces although separated by brick walls have a flue in common as shown in Figs. 1 and 2.

The fires are lighted by a laborer about two hours before the employes arrive, and the crucibles which are left in the furnace over night, are filled. The molds are set on top of the furnace to be heated to the proper temperature for the first heat.

Casting the Metal.

After the molds have attained the proper temperature they are taken from the furnace and coated with a thin film of black lead or spanish white, cores that have been similarly coated are then inserted and the mold is clamped together by an ordinary thumb screw. The coating, which consists of either black lead or spanish white, mixed with water, is poured onto the molds and prevents the metal from adhering.

The metal is stirred for about a minute, the dross skimmed off and the metal is taken out of the crucible with a small ladle of sufficient capacity to fill the mold. If any metal remains in the ladle it is poured back into the crucible. All of the operations are performed on top of the furnace. As soon as the mold is poured, the metal cores are pulled out, the clamp taken off and the mold is gently tapped to knock out the casting. The sprues are thrown back into the crucible while hot thus reducing the temperature of the metal only slightly. The entire operation is performed in a very short time and the daily output of castings is very large.

Complicated Molds.

Some of the molds are very complicated, consisting frequently of no less than 50 parts. These require considerable time to assemble. Large molds are heated over gas jets located behind the men engaged in pouring and by this arrangement there is practically no lost time in carrying the molds from the gas heaters

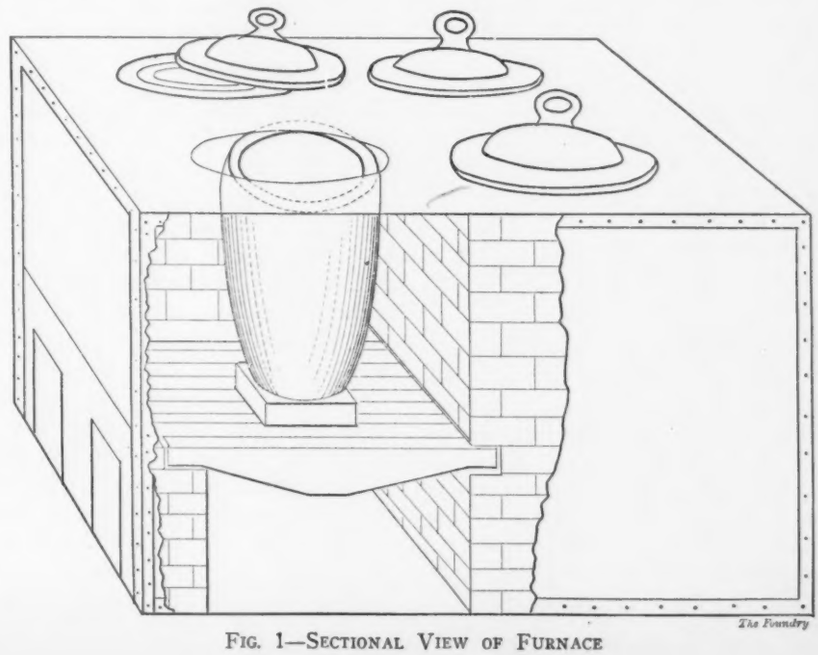


FIG. 1—SECTIONAL VIEW OF FURNACE

to the furnaces. Although the complicated molds which consist of numerous sections are expensive, nevertheless the first cost is the only one to be considered, and as the molds can be used for thousands of castings, the cost of making the mold apportioned to each casting is very small.

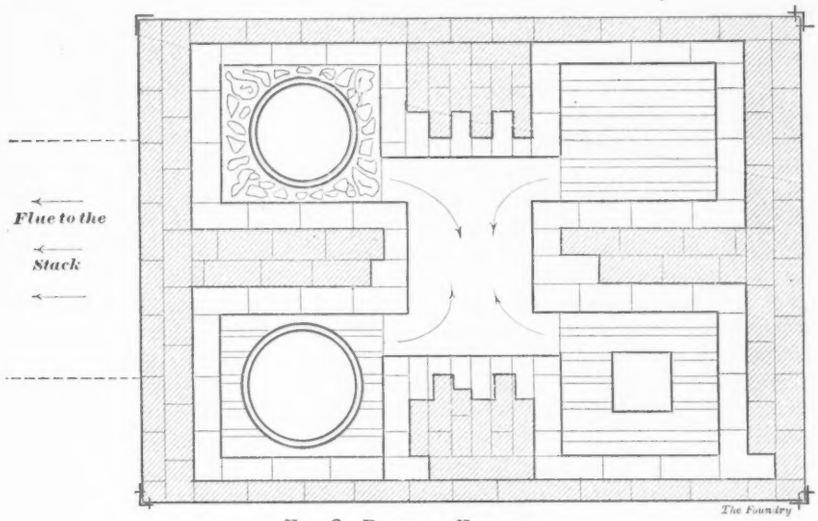


FIG. 2—PLAN OF FURNACE

Permanent Molds.

Fig. 3 shows the mold for a gear with the cores for the center and set screw holes in place. The mold is ready for pouring as soon as the clamps are adjusted.

Fig. 4 shows a section of a mold of an automobile carburetor. In three different parts of this mold the threads are to be cast on. Carburetors and similar castings requiring a close grained metal are made from the second mixture. Valve castings cannot be made from these alloys, being wholly unsuited for this class of work. There is, however, a wide field for this metal. These alloys are patented in both France and Germany and the two concerns report large earnings.

DRAWING BOARD.

In the majority of pattern shops each patternmaker is provided with a large drawing board which varies in size from four to eight feet in length and three to five feet in width. Some are well constructed, while others are just thrown together on wooden horses. I worked in the pattern shop of a large engine manufacturing company in the west, where all tools, jigs, etc., were constructed in a workmanlike manner. The drawing or laying out boards were all made a standard size. The edge of each board was jointed, but not glued, and no nails nor screws were used to hold them together. Instead of the nails and screws, a dovetail was cut into the under side, and in this was driven a batten, as shown in the accompanying illustration. The boards were made from 2-inch pine lumber, dressed in two sides. The dovetail held the boards together securely, and when the top required dressing, the batten was driven out and each board was put through the planer, after which they were fastened together clean and true. All the wooden horses on which the drawing boards rested were made the same height, so that it was possible to put all of the boards in the shop together when desired.

D. B.

FOUNDRIES ON THE ISTHMUS.

With its machine shops, foundries, erecting shops and its other mechanical activities, the Isthmus of Panama has taken on the appearance of a modern industrial community teeming with American force and energy. The constructive and repair requirements of the canal construction work are of immense proportions, as the extensive plants and equipments in operation clearly indicate. The principal foundries are located at Gorgona, where a building 70 x 120 feet is equipped for making 800,000 pounds of gray iron castings and 70,000 pounds of brass castings per month. It contains three cupolas and six brass furnaces, with the necessary core ovens and other equipment.

ANNUAL BONUS DISTRIBUTION.

Wyckoff, Seamans & Benedict, Ilion, N. Y., distributed $13,800 in gold as a bonus from the earnings of 1907, among 276 selected employes. More than $130,000 has now been distributed in this way to the most efficient of the employes who have retained their positions for 10 years or more. Among the men who received portions of this bonus, two have been employed 30 years, thirteen 25 years, forty 20 years, eighty-four 15 years, and 137 10 years.

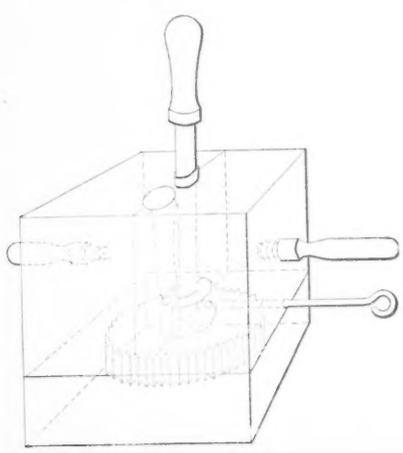


FIG. 3—MOLD FOR GEARS

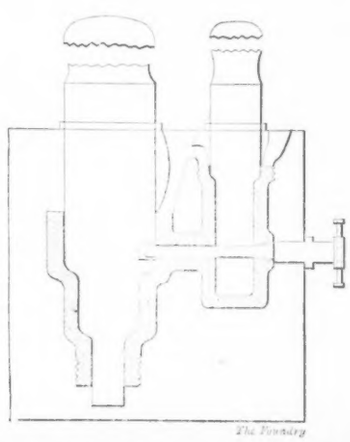
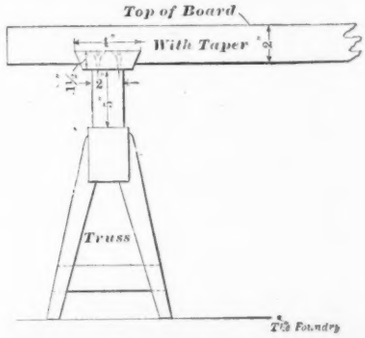


FIG. 4—SECTION OF MOLD FOR CARBURETOR



DRAWING BOARD

ALLOYS FOR RAILROAD BEARINGS*

The History and Development of these Mixtures in the United States—Standard Alloys

BY G. H. CLAMER

IN THE earliest days of railroading, the alloys used for bearings were those which had been adopted in general machine construction; the favorite alloy seemed to be copper and tin. This alloy was adopted, not because it had any particular merits which were proven, but because it had given satisfactory results on stationary engines, etc., and this was all that was apparently known about it. Then it was about the most expensive combination of the common metals that could be made, which was sufficient endorsement of its excellence.

Furthermore, the prevalent idea in those days was to make an alloy as hard as possible. It was well known that tin, when added to copper, hardened it, and naturally as much tin was added as was possible without making the alloy too brittle. Consequently, bearings were made with four parts copper to one part tin, or 80 per cent copper and 20 per cent tin (in reality bell metal), and from this on down to nine parts copper to one part tin. Seven parts copper and one part tin for many years was considered the standard of excellence—that is, 87½ per cent copper and 12½ per cent tin—and is still specified by a few railroads, although these specifications are seldom enforced, as the mixture today is considered entirely too expensive.

In those days, that is before 1870, the equipment was light, and speeds so slow that almost any kind of bearings would answer. A few hot boxes en route were expected, and a traveler would consider himself fortunate should he reach his destination without detention, due to this cause. He was content to dine in Philadelphia and breakfast in New York; the idea of dining in Philadelphia and breakfasting in Chicago was beyond his wildest dreams.

Standard Bearing.

The Railway Master Car Builders' Association in 1872 adopted its first standard design of bearing. Before that time no standard whatever was recognized; each master mechanic or car builder had his own idea as to the design of bearing, and consequently the equipment included bearings of almost every conceivable form. Naturally no interchange was possible, in fact, the interchange was only then becoming necessary because of cars being taken from one road to another. The standard size then adopted was 3¼ x 7 inches. The sizes of the standard axle and journal have been increased from time to time to meet the demand for heavier equipment, and this has necessitated larger journal brasses. The Master Car Builders' Association has adopted a standard brass for each size axle, differing, however, only slightly from the original design. Fully 95 per cent of the cars built today are equipped with bearings of standard design. Cars are today sent from Maine to Texas, and from coast to coast, operating for months on a foreign road; were it not for the standardization of equipment, cars might be held up for long periods at distant points because the road, in whose custody it is, has not the proper equipment to repair it.

The First Standard Alloy.

The copper and tin alloy, made in the proportion of seven to one, was until 1887 considered the standard alloy for railway bearings. This standard was maintained principally for the reason that the manufacture of railway bearings, for 17 years before that time, had practically been in the hands of one company. This concern in 1870 placed on the market a lead lined bearing. This invention consisted of nothing more than the application to the bearing surface of a thin lining of lead. The lining was applied by first tinning the journal surface of the bearing and then placing it against a mandrel, and pouring as thin a lining as possible of pure lead between the bearing and the mandrel, the molten lead attaching itself firmly to the tinned surface of the bearing. Hopkins thus produced what he called a self-fitting bearing.

Because of the constantly increasing weight and speed of trains about the time of this invention, the bearings were becoming more and more troublesome. The trouble was aggravated by the fact that the bearings were hard and unyielding, being made of the 7 to 1 alloy, and heated rapidly. The lubrication was by no means as satisfactory as it is today, and dust-guards were little used. The invention referred too, like many others of the same simple nature, solved the difficulties in a remarkably satisfactory manner, and so evident were its merits that it was almost universally used.

Introduction of Lead and Phosphorus.

Before the expiration of this patent, Dicks, of England, secured a patent covering the introduction of lead and phosphorus into the copper and tin alloy for bearings, claiming that the lead added to its efficiency. This alloy was manufactured by the Phosphor Bronze Smelting Co., and became known as the "S" brand—other alloys, containing phosphorus, having been manufactured for other purposes. This brand consisted of 80 parts copper, 10 parts tin, 10 parts lead, and 1 part phosphorus and was adopted by the Pennsylvania railroad as a result of a series of tests, made by Dr. Dudley. He proved what had already been a fairly well founded theory, that the addition of lead to the copper and tin alloy was really of very material benefit. The phosphorus was added for its supposed beneficial influence in the foundry. Phosphorus is a deoxidizing agent and has the property of rendering the metal exceedingly fluid. As a result of his experiments, Dr. Dudley drew up specifications which, so far as I am aware, were the first covering the composition of an alloy for railway bearings. The specification was that of the phosphor bronze "S" bearing metal, and described certain limits for each constituent, and a limitation on impurities. It read as follows:

*Presented at the annual meeting of the American Society for Testing Materials.

Copper	78 to 80
Lead	8 to 11
Tin	9 to 11
Phosphorus	7/10 to 1 per cent

All ingredients foreign to above, not over 1/3 of 1 per cent.

Shortly after the introduction of the phosphor bronze bearing metal, my father commenced the manufacture and sale of metal containing

77 parts copper,
11½ parts tin,
11½ parts lead,

without the use of phosphorus. This was about 1876. After selling this product in a very limited way, he interested the Elkins Mfg. Co., but it was found difficult to introduce. First, because of the prevailing prejudice against anything except copper and tin, this metal being looked upon as a fraud because copper and tin was debased by lead. Second, because of the competition of phosphor bronze "S" brand, which was recognized by the Pennsylvania railroad as an alloy of merit; and, third, because the Hopkins lead lined car bearing patent had not yet expired—the bearings of Ajax metal were not sufficiently soft to operate satisfactorily without lead lining. For engine bearings, however, it found favor, and sales increased steadily. In 1880 the manufacture and sale was taken up by the Ajax Metal Co., and the production continually increased. Some years later other manufacturers came into the field.

Dr. Dudley appears to be the first, and perhaps the only one, who has actually taken in hand a practical and scientific study of the alloys for railway bearings. During his long connection with the testing department of the Pennsylvania railroad he has had occasion to study practically all the alloys of promising qualities which have from time to time been presented. About 1890 Dr. Dudley conducted tests whereby he compared the copper and tin alloy, which consisted of seven parts copper and one part tin, with the above-mentioned "S" brand phosphor bronze. Without discussing any of the details of these tests, which were published in the *American Engineering and Railway Journal* in 1892, I will simply quote the conclusions which he drew from the data obtained:

First—Phosphor bronze showed less tendency to heat.

Second—Phosphor bronze showed a slower rate of wear.

Third—The phosphorus in the alloy apparently did not affect materially the performance of the bearings in service, and is added only for beneficial influences in the foundry.

Fourth—The superiority of the "S" brand phosphor bronze is therefore due to the lead which it contains.

Having noted the beneficial influences of lead, it became a question as to how much lead should be added, also what relationship the quantity of tin had upon the properties of the alloy. With these questions in mind, further tests were conducted which resulted in the establishment of the following facts, which were published in the *Journal of the Franklin Institute* in 1892:

First—Wear diminishes with the increase of lead.

Second—Wear diminished with the diminution of tin.

Third—The tendency to become heated decreases as the lead increases and the tin decreases, or in other words, as the plasticity of the alloy is increased.

Proportions of Tin and Lead.

These facts having been established by numerous tests, a still further problem confronted Dr. Dudley. It being true that the valuable properties of the alloy increased in the direction indicated, how far could the decrease of tin and the increase of lead be extended, and still maintain sufficient compressive strength, so that the bearings would not distort under the loads which they are called upon to carry. The tests he conducted were with percentages of tin from 8 to 12½ per cent, and lead from zero to 15 per cent. None of these alloys showed indication of distortion in service. The alloy 8 per cent tin, 15 per cent lead and 77 per cent copper proved to be the best of the series. To this a small percentage of phosphorus was added (¼ of 1 per cent) for foundry purposes. This alloy he called E. X. B. metal.

Dr. Dudley, in one bold leap, then tried to make an alloy of 4 per cent tin, 20 per cent lead and 76 per cent copper, but he failed in his attempt to produce a homogeneous alloy of this composition; as he expressed it, "a very funny difficulty was encountered, that is, the lead segregated," and further experiments in this line were abandoned. It is generally believed that lead and copper do not alloy, and can not be made into castings. It is true that lead and copper have a very weak affinity for each other, and this, combined with the great difference in the melting points and specific gravity of the two metals, makes it impossible to get castings which can be said to be really homogeneous, unless they are small, thin sections, which can be rapidly cooled. A copper and lead alloy does not make what would be called good castings, although they may be fairly well mixed; by the introduction of tin, a more homogeneous product is secured.

It was the knowledge of these facts no doubt which led Dr. Dudley to abandon further efforts in the direction of increasing his lead and decreasing his tin beyond the proportions of E. X. B. metal. Why his efforts to make an alloy of 4 per cent tin, 20 per cent lead and 76 per cent copper failed is hard to determine, as the alloy is made with the simplest kind of foundry manipulation. In all probability, when attempting to make this alloy, Dr. Dudley had present some impurity—phosphorus, perhaps—which was detrimental to the best results. Knowing that tin added to the homogeneity of the copper and lead alloy, it was thought by Dr. Dudley and others that the higher the amount of tin the greater would be the amount of lead which could be homogeneously combined. The segregation of the alloy that he endeavored to make was attributed to the low tin content instead of impurity or foreign element.

Experiments With Nickel.

At this point the work on the copper, tin and lead alloy was taken in hand by Joseph G. Hendrickson and myself. We conducted experiments, first with the idea of introducing some element which would cause a quick chilling or rapid setting of the metal after entering the mold. After trying additions of practically all the high melting point metals, we found that nickel was the only one which really gave satisfactory results. Nickel was found to alloy readily with copper and tin, and caused it to set quickly; at the same time, it increased its tensile and compressive strength. By the use of nickel, we were enabled to increase the lead considerably above the former standard as set by Dr. Dudley, that is 15 per cent, while still maintaining tin at 8 to 10 per cent.

We also found it possible to lower the tin content, and even to entirely dispense with it, and still secure a satisfactory alloy for casting, the alloy of copper and lead being found to be more homogeneous when nickel was added than copper and lead alone, although it was found that no advantage could be gained by substituting nickel for tin in order to get the same amount of hardness. Further than this, we found that it was possible to make alloys with small percentages of tin and large proportions of lead without any nickel or

the addition of high melting point metal.

Use of Lead.

The fact that lead, without nickel or other admixture, or special treatment of any kind, in large quantities could be added to a copper and tin alloy that is far beyond 15 per cent with tin below 8 per cent—the limits of Dr. Dudley's E. X. B. alloy—was a surprise to us, as there had always been a deeply rooted idea in the trade that such an alloy could not be made successfully. That this idea was entirely erroneous we proved beyond doubt, and as the result of many experiments, we found that as a matter of fact it was entirely due to the diminution of tin from the previous standard that it was possible to proportionately increase the lead as the tin was diminished, stopping only at such a point with the increase in lead and decrease in tin when the compressive strength was so reduced that thoroughly practical and commercial bearings no longer resulted. This point we found to be

Tin ..... 5 per cent
Lead ..... 30 per cent
Balance of the alloy, 65 per cent copper.

This alloy is largely sold under the name of "plastic bronze."

It has a compressive strength of about 15,000 pounds per square inch, and is found to operate without distortion on the bearings of the heaviest locomotives in service, and is used not only for driving brasses, but also for rod brasses and bushings where considerable thrust is encountered.

It is also used in vast quantities on cars of 100,000 pounds capacity, which are the largest cars now in service.

It was well known, as a result of Dr. Dudley's experiments that it was highly desirable for bearing purposes to increase lead and decrease tin in copper, tin and lead alloys, not only for the added excellence of the product, but also because of the decrease in the cost, tin and copper being replaced by lead, a cheaper metal. Two causes of the segregation of lead which were undiscovered were undoubtedly responsible for this erroneous theory. First, tin above a certain limit; second, presence of detrimental amounts of certain other elements existing as impurities.

Microscopic Examination of Alloys.

An explanation as to why it was possible to increase the lead by diminishing the tin was found by a microscopic examination of such alloys. It is clearly shown by examining the structure of copper-tin-lead alloys that the lead is but mechanically held, the copper and tin form a network or matrix, which acts as a supporting structure for the lead, and gives to the alloy its strength and hardness. An examination of the copper and tin matrix showed it to be made up of what we at the time considered free copper and a chemical compound Sn Cu 3, together with a eutectic alloy if the tin was sufficiently high. This eutectic alloy has a very much lower melting point than the balance of the alloy, and consequently, if present, requires a considerable period of time to solidify after entering the mold, and owing to the time required, the lead, which has a very much lower melting point than the eutectic alloy and a very much higher specific gravity, has abundant time to liquate to the bottom of the casting, thus producing an entirely unsalable product. If, however, the tin is kept within the limits where this eutectic alloy is not formed, the whole matrix solidifies at a comparatively higher temperature, and therefore solidifies so quickly that the lead has no opportunity to separate, the result being an entirely homogeneous alloy. The point where we found a critical change to take place in the matrix was approximately 9 per cent tin and 91 per cent copper. If the matrix were so proportioned that the tin remained below 9 per cent, more than 20 per cent lead could be added with satisfactory results. Furthermore, as the tin is decreased below this percentage, a correspondingly greater amount of lead could be added.

Messrs. Heycock & Neville have since made a very exhaustive examination of the copper and tin series of alloys, the results of which were published. In this thesis they located very accurately this critical point in the constitution of copper and tin alloys at 9 per cent tin, and described the constitution of those alloys containing less than 9 per cent as solid solutions of copper and tin, whereas, beyond 9 per cent they consist of solid solution of copper and tin, together with the compound Sn Cu 4.

Besides the alloys so far considered there are a number of other compositions described in specifications of various railroads. These specifications all cover alloys with tin from 8 to 10 per cent, lead from 10 to 15 per cent, with various details as to limitations of the various metals and impurities. There has also been used continuously since 1887 vast quantities of bearings which are made entirely from scrap. Such bearings have the following composition:

Copper ..... 65 to 75
Tin ..... 2 to 8
Lead ..... 10 to 18
Zinc ..... 5 to 20

For engine bearings more care has been exercised, and only alloys of approved composition have been used, although within the last few years there has also been a tendency toward the use of unknown scrap compositions even for engine bearings.

USE OF BORINGS FOR ANNEALING SCALE.

By Dr. Richard Moldenke.

A number of years ago the custom of adding cast or steel borings to the scale used for packing about castings to be annealed came into vogue, and has continued more or less to the present time. The object at the time this was introduced, was first to get rid of a drug on the iron market, and second to take up the burning effects of any stray air that might get into a pot and thus save the sharp edges of the castings.

A correspondent asks about the quantity to be used. First of all it is better to prevent the trouble than to correct it; that is, to lute up the pots properly, so that small currents of air cannot enter and circulate about the castings, which should be packed so tightly in scale that no openings are left between them. This will obviate the use of any borings.

However, if it is an economic question, that is if the borings cannot be sold, the supply that comes from the machine shop can be scattered on the scale piles every day in any quantity up to the amount which will not be oxidized in the first anneal. That is, if so large a quantity of the borings is used that when dumping the pots a large amount has remained unoxidized, or only partly so, more has been put in than was necessary to accomplish the object desired. Reduce the amount accordingly.

As a general rule there is seldom more than a fraction of a per cent of the annealing scale used daily, from borings made in the machine shop of a malleable works, and hence the question is not a very live one. If a good price can be obtained for the borings it is better to sell them than to add to the scale.

BRASS FOUNDRY DIFFICULTIES SOLVED

Melting Brass on a Forge—Spongy Castings from Excessive Dross—Melting Nickel

BY C. VICKERS

QUESTION:—Is there any practical way of melting brass on a common blacksmith's forge and what are the troubles to be expected?

Answer:—Brass can be successfully melted on a blacksmith's forge, and the difficulties which will be encountered will be found to be due entirely to the inconvenience of such a method. We have successfully melted brass in this manner by building up a small furnace on the forge, consisting of a ring of fire bricks around the tuyere. The diameter of a furnace of this kind is naturally dependent on the size of the crucible to be used and owing to the limited space in which this work must be done, the crucible is necessarily small. A No. 18 will answer.

Stand the crucible on the tuyere and place the first layer of brick in a circle around it, leaving a space of about 3 inches between the brick and the crucible. Build up the wall, using any kind of mud in the joints, and carry this wall of brick two courses above the top of the crucible. Light the fire and get a bed of coke level with the second course of brick, on which the crucible should then be placed, and charge with the coke all around to the top. As the coke burns away around the sides replace it with a fresh supply and when the metal sinks down in the crucible add to the mixture. Charcoal should be kept on top of the metal to avoid spongy castings.

This is melting brass on the "Catch as catch can" principle, and if you are liable to resort to this method frequently, your furnace wall might be made permanent, so that it may be easily removed.

It might be advisable to make a sheet iron ring or casing lined with fire brick, which can be securely held in the casing by a circular ring or ledge of sufficient width to hold the brick in place. Another ring can be bedded in on top of the brick and both rings can be fastened together by bolts passing through holes in the rings on the outside of the furnace. A couple of handles could also be placed on the furnace, so that it can be readily lifted on and off the forge as desired, so that you can convert your forge into a furnace within a very few moments. Without this wall it is not practical to melt brass on a forge, except in exceedingly small amounts.

ACTION OF ACIDS ON ALUMINUM ALLOYS.

Question:—We would like to have mixtures of several aluminum alloys that will withstand the action of acids. The metal is to be used in the manufacture of cylinders that are to revolve at a high speed. The metal must be tough, and should be able to withstand a high pressure, and at the same time the mixture should be as cheap as possible. We have tried several different alloys, but when the metal came in contact with water, it tarnished and turned black. Can you give us an alloy that will not tarnish?

Answer:—There is no aluminum alloy that will not tarnish in the presence of acids. This metal at one time had the enviable reputation of being acid proof, but experience has not sustained this theory—in fact, aluminum is very easily attacked by acids. Muriatic acid will dissolve it as readily as it will dissolve zinc, and hydrofluoric acid greatly diluted will dissolve aluminum very rapidly. All acids will turn aluminum black. The metal cannot be dipped bright, and any alloy containing a large percentage of aluminum is necessarily affected in the same way. You will undoubtedly be unsuccessful in using aluminum for such work and will be compelled to substitute some other metal and suggest the use of white bronze.

MELTING NICKEL IN A BRASS FURNACE.

Question:—Can nickel be melted in a crucible in a brass furnace, or is its melting point so high that this cannot be done? The furnace in which I desire to melt it is one in which Connellsville coke is used for fuel and is of the free draft type, having a chimney about 20 feet in height.

Answer:—This will depend on the temperature of the furnace. If the stack is only 20 feet in height above the flues then I doubt if you can successfully melt nickel, but if it is 20 feet above the roof you can, although much depends on the diameter of the stack, the size of the flues connecting the furnace and the skill of the melter. Nickel melts at a temperature somewhat lower than that of wrought iron, and if you intend to melt it in quantities it is advisable to use a steel melting crucible and adopt methods similar to those used in the melting of steel in coke furnaces.

These include briefly, the use of a base under the crucible, a piece of a refractory fire brick will do, placed on a grate bar before lighting the fire. When the fire has been started, scrape all of the coke from the brick and place on the latter a parting of silica sand, to prevent the crucible from melting to the brick. Then place the crucible in position, charge the coke, using a good Connellsville grade, charge the crucible and place over it a cover made of a bottom of an old crucible, having a 2-inch hole in its center.

Cover the hole with a piece of brick and bury the crucible with coke. When the furnace reaches a white heat remove the cover, poke down the incandescent coke from the top of the crucible, charge fresh coke and continue this until the entire charge is melted. You can ascertain when the charge is melted by inserting a thin iron bar into the crucible through the hole in the cover.

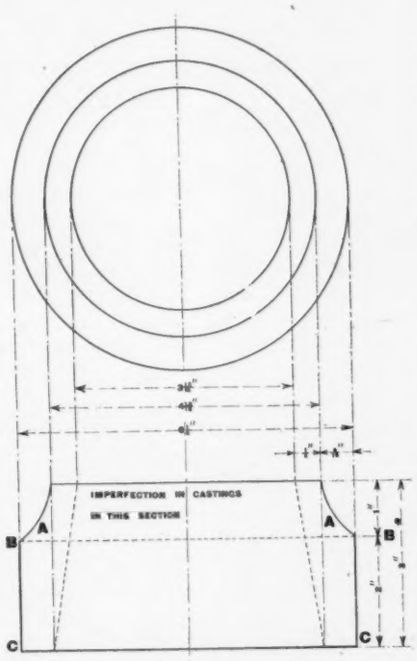
As nickel is reduced from its oxides by charcoal at high temperatures, it is necessary to use this as a covering for the metal, the same as in melting copper. The use of this method of melting nickel in coke hole, will result in more rapid melting and hotter metal than if the usual brass foundry methods were pursued. If, however, you do not desire to melt the nickel in large quantities, but are only making an alloy of copper you do not need to melt the nickel first, but charge it directly into the crucible with the copper and proceed as in melting copper. When the copper melts it will dissolve the nickel. Zinc also possesses this property. Nickel and zinc can be charged together and melted, and can be held at the flaring point of zinc for a brief period; when the alloy of zinc and nickel is formed.

DROSS DIFFICULTIES.

Question:—We are having trouble with brass castings weighing about 10 pounds apiece, which are to be made of a close-grained metal. The pattern only allows 1/16 inch for finish and when they are turned up there seems to be a defect in the face which looks like dross. The lower portion of the castings, however, seems fairly good. We are using the following mixture: New ingot copper, 16 pounds; tin, 1¼ pounds; zinc, ¾ pound; lead, ½ pound. The metal was cast direct without being made into pigs. The castings have a green sand core four inches in diameter. They are made in a cheek and poured from the bottom and the molds are provided with two small risers. Two gates are cut in the bottom of the molds and we gated them at the top with the same results. The metal drops about seven inches to the bottom of the gate when pouring in cheek and about four inches when gated on the top. What shou'd the cost of this casting be, using this mixture?

Answer:—Any dross in the metal would naturally lodge at A, in the accompanying illustration, inasmuch as the upper portion of the rising column of metal would be held at this point, and would move more slowly, owing to the increasing area of the casting. The narrow portion above the curve would also choke back this slowly moving colder metal, and the hotter metal underneath would be forced through by the increasing pressure. It would be forced through around the core, throwing the colder dross bearing metal against the curve.

Probably the easiest way to overcome this difficulty would be to build up the pattern at this point, and turn off the surplus on the casting, which would cut out the defect, as a sixteenth finish is insufficient for this part of the casting. There are several other suggestions that might be made, including the gating at this point, and the pouring of the metal hot. The cheek parting would then be made at B instead of C, two inches of the casting then being in the nowel. If this undu'y increases the cost of molding, a change in the metal mixture is suggested. A study of this alloy indicates that it is one that is liable to run unsound if not very carefully melted, as there is no margin of safety owing to the small percentage of zinc carried. Zinc is the deoxidizing element in this mixture. Without it there is great danger of porous castings, as neither lead nor tin will make copper castings sound. Four per cent of zinc is insufficient to insure solid copper castings. They can be made with such a low percentage, and even less, but this is not advisable for ordinary practice. The alloy can be improved by either increasing the percentage of zinc to about 6 per cent, or eliminating it entirely, and using a more energetic oxidizer, such as silicon, manganese, aluminum or phosphorus. Silicon is the most powerful, but it is out of the question in this case, owing to the presence of lead in the mixture, and experience has proven that manganese is not to be considered in this connection. Aluminum will increase the dross. There is nothing left, therefore, except phosphorus, and if the zinc is left out of the mixture entirely, 2 per



SECTIONAL VIEWS OF CASTING

cent phosphor-tin should be used, replacing that amount of ordinary tin. This will result in an improvement in the casting.

It is extremely difficult to give satisfactory figures as to the cost of such castings, as this depends entirely upon the price of the metals and the cost of production, while the latter may be greatly influenced by the use of special labor saving equipment.

CASTING NICKEL.

Question:—We have considerable trouble cleaning our nickel castings after they have been shaken out. The sand adheres so firmly that it has to be chipped off with a chisel. How can this difficulty be overcome?

Answer:—You can solve your difficulties by using a more refractory sand for facing the molds. Your sand does not withstand the great heat or the high temperature of melted nickel. It fuses and adheres to the castings. If you have any doubts, try this experiment. Fill an old crucible with the sand you use and expose it to the temperature necessary to melt nickel. At a white heat the sand will fuse into a slag and will adhere to the bottom and sides of the crucible, proving that it is unfitted for use at such temperatures. It would be advisable for you to copy the methods of the steel casting makers and face your molds in the same way. Use silica sand for your facing and bind it with fire clay and molasses. Silica sand alone cannot be used satisfactorily for molding purposes, but you can add clay in any proportion that you find necessary to obtain the required strength in the sand.

You can try six, eight or ten parts of sand to one of clay, mix dry, and wet with strong molasses water. If the sand is damp, add the molasses without any water and mix thoroughly. These facing sands are greatly improved if ground in a mill, otherwise they should be well trodden under foot and passed through a sieve several times. The object is to secure a facing equal in packing qualities to your molding sand. This facing is used next to the pattern and is backed up by ordinary sand. To make smooth castings the steel foundry uses a silica wash.

Silica facing can be obtained from the supply houses and it is mixed with water and molasses and painted on the molds. For your work a good grade of plumbago might be best adapted, as it can be used dry and you thereby avoid the skin-drying of the molds, inasmuch as when you paint on the silica wash you will be obliged to dry your molds. The metal can, of course, be cast without the use of either the plumbago or the wash and we believe that if the coarser particles of sand are sifted out of the facing the castings will be found to be sufficiently smooth.

MIXTURES FOR FITTINGS.

Question:—Can you give me a mixture suitable for bib and cock work? We would like to make this without the use of tin.

Answer:—Try the following alloys:

Copper, 80 pounds; zinc, 15 pounds; lead, 5 pounds.

(2) Copper, 64 pounds; zinc, 20 pounds; lead, 2 pounds.

(3) Copper, 50 pounds, zinc, 20 pounds; lead, 2 pounds.

A MODEL GRAY IRON FOUNDRY

Description of the New Plant of the Goulds Mfg. Co.—Core Departments and Pattern Storage

THE GOULDS Mfg. Co., Seneca Falls, N. Y., manufacturer of pumping machinery, last August occupied a new foundry erected at its No. 2 plant. Built some years ago, this plant is gradually being enlarged so that eventually the No. 1 works in another section of the town will be abandoned. The new foundry has been designed so that it is of ample size to provide castings for both plants at present and for the completed No. 2 plant, when the older one has been abandoned.

Foundry.

The foundry building proper is 500 feet long and 100 feet wide. The building is of steel frame construction with brick side walls and a concrete roof which forms a large monitor over the central bay. Four skylights let into the roof and extending the entire length of the building provide ample light in the interior. The central bay is spanned by a 20-ton Alliance Machine Co. double-trolley five-motor crane, while in each of the two side-bays are two three-ton Niles cranes, each extending one-half the width of the bay. At the east end of the building on two adjoining columns are two five-ton electrically driven jib cranes with a radius of 19 feet. These cranes are used for the pouring and handling of large castings. The runway of the 20-ton cranes in the central bay extends 100 feet to the east of the building, Fig. 4, providing crane service for the flask yard, also permitting railroad cars to be loaded on the outside of the foundry. A swinging door closes the opening through which the crane passes and is operated by an electric switch.

Internal Transportation.

When the foundry was designed internal transportation was provided by means of mashways or avenues, consisting of cast iron plates laid into all parts of the foundry which it was desired to reach with trucks or ladles. The illustration, Fig. 1, shows one of these avenues extending along the central bay of the foundry. Cross avenues lead from this central avenue to various points in the side bays and also to the cupola room. For transporting molten iron to the molds buggy ladles are run along these avenues to the various floors. These have been found more or less unsatisfactory and are about to be replaced with a narrow gage industrial railway, reaching the same points as the avenues and fitted with turntables instead of switches at the junctions.

Cupola Room.

The cupolas have been located in the side bay in a room partitioned off from the rest of the foundry by a brick wall. This room is 60 x 40 feet and is equipped with one 92-inch Colliau cupola, one 72-inch cupola built by Byram & Co., and a 48-inch cupola formerly located in the old foundry. These furnaces have been jacked up 18 inches to permit a reservoir to be placed under their spouts from which the buggy ladles and pouring hatches are to be filled. These reservoirs each have a capacity of three tons. The spouts from the cupolas project through the wall into the main foundry.

Installed in the cupola room are two wet rattlers for recovering the iron lost when the bottom of the cupola is dropped. The charging platform is reached by a hydraulic plunger elevator on which the charging cars are carried. These are returned to the ground by means of an inclined narrow gage railway, Fig. 6, which has a dead end incline at its opposite end up which the cars run and from which they are switched back upon

FIG. 1—MAIN BAY OF THE FOUNDRY OF THE GOULDS MFG. CO., SHOWING ONE OF THE MASHWAYS

FIG. 2—ANOTHER VIEW OF THE FOUNDRY. IRON FLASKS ARE USED ALMOST EXCLUSIVELY

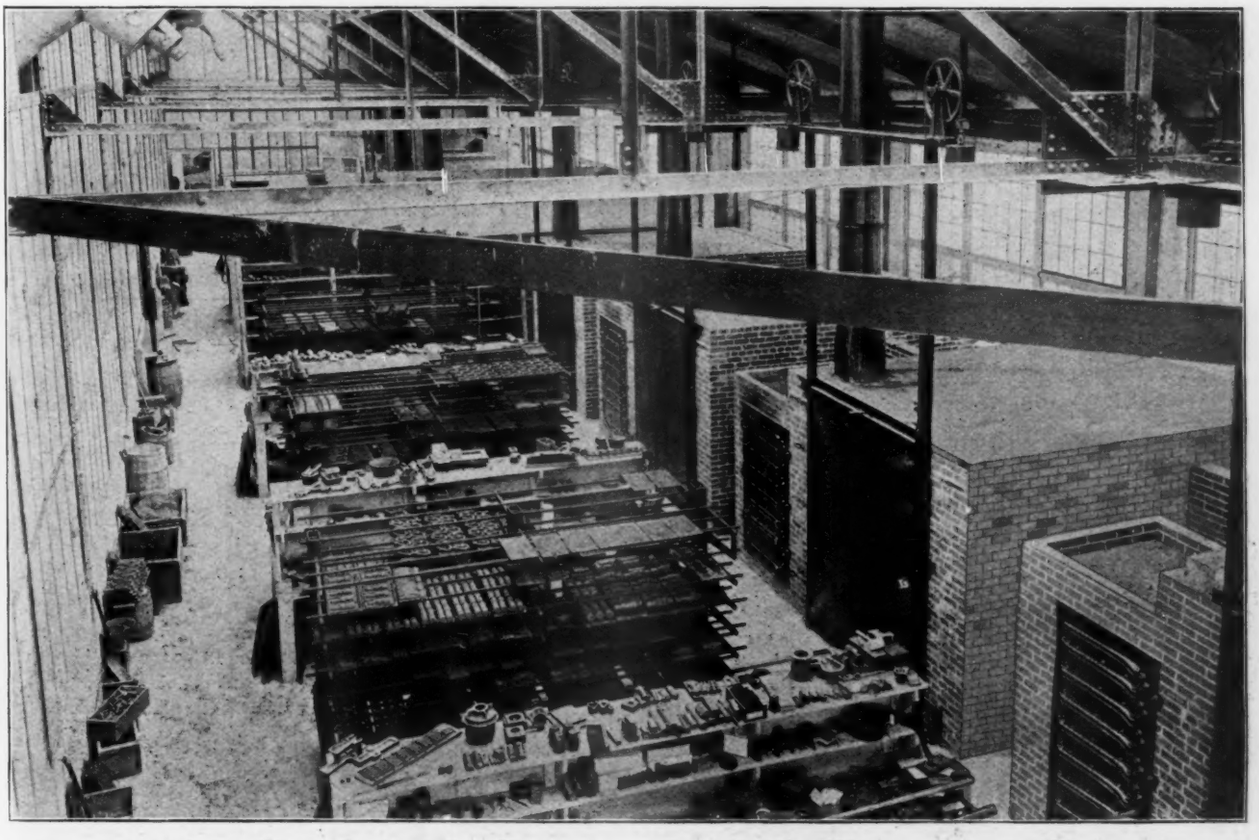


FIG. 3—DEPARTMENT FOR SMALL CORES. THE OVENS ARE LOCATED NEAR THE BENCHES. THE LIGHTING AND VENTILATING FACILITIES ARE UNEXCELLED

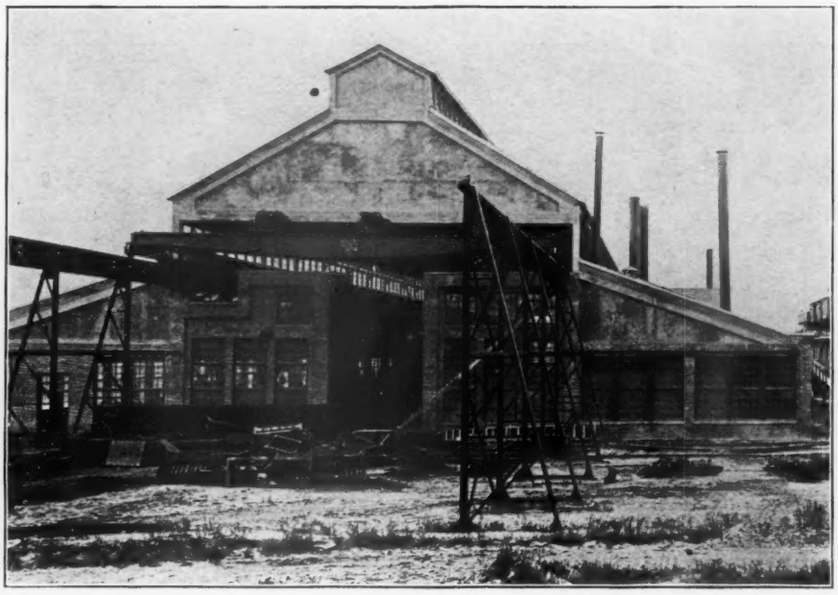


FIG. 4—CRANE RUNWAY EXTENDING THROUGH THE MAIN BUILDING AND COMMANDS THE FLASK YARD

the proper tracks leading to the storage bins. On the second floor of the cupola room are located two blowers which supply warm air to the foundry for heating purposes.

Blast is furnished for the 92-inch cupola by a Roots blower, driven by a 60-horsepower motor, and for the 72-inch cupola by a Connellsville blower driven by a 25-horsepower motor. The 48-inch cupola receives blast from the blast pipe of the large cupola. These blowers are installed in a blower room adjoining the cupola room on the north. In this room is also installed an Ingersoll-Sargeant compound air compressor with a capacity of 350 cubic feet of free air per minute. This furnishes air for operating the hoists and molding machines in the foundry. In this room also is installed a power pump for supplying pressure to the elevator leading to the cupola charging floor.

Molding Equipment.

A majority of the jobs in the foundry except the large pump bases could be made on a molding machine, although a large amount of floor and bench work is done. Fifteen Tabor machines of various types are installed, and in addition there are a number of rockover machines used in molding hand pump casings, and several Delano pulley molding machines. A noticeable feature of this foundry is the large amount of floor work done, many jobs which ordinarily would be done on the bench are molded on the floor. Metal patterns are used to a large extent and in an unusually large number of cases the patterns are mounted. The greater part of the work is done in green sand, although some dry sand work is done on the larger castings. Metal flasks are used almost entirely and snap flasks are used only in the brass foundry.

Core Rooms.

Cores are made in two departments. Small cores are made in a room partitioned off in one of the side bays, Fig. 3, which has an area of 160 x 40 feet. The partition separating it from the foundry is a steel framework filled in with ribbed glass. In it are installed seven large core ovens of such size that a car can be run into them on tracks laid in the core room,

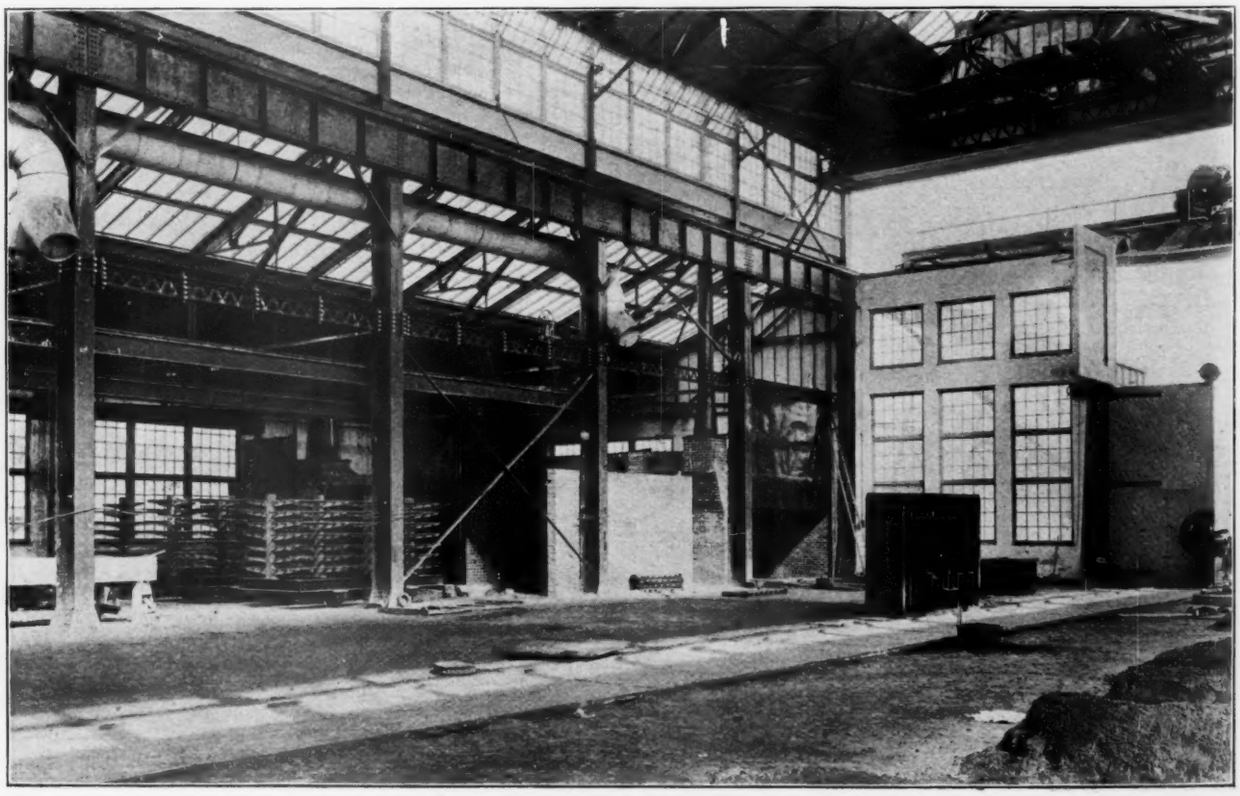


FIG. 5—OVENS FOR BAKING LARGE CORES

and five Millet core ovens, each being erected immediately adjoining one of the large ovens and both use the same stack. The doors to the large core ovens are hung with flexible cables and counterweighted. An unusual feature of these core ovens is that the furnaces are located at the rear and below the ovens and are separated from the main core room by a brick partition. Fuel for the furnaces and the ashes therefrom are handled in the passageway behind this partition and all dust and dirt incident to this work is kept out of the core room. In front of the furnaces are installed the core benches. There are seven double benches at each of which three coremakers can work. These are located between the tracks and at such distance from them that the coremaker has only to swing around on his stool in order to place completed cores on the cars, resulting in a great saving of time and labor in the handling of cores.

Another unusual feature of this core room is the core storage room which is placed about the middle of the core room and separates the core ovens into two groups. In this room are stored cores which are made in excess of the day's requirements.

The heavy cores mostly used in the castings for large triplex pumps are made in one corner of the main foundry, and are baked in the ovens shown in Fig. 5. One of these, at right angles to the axis of the building, is for baking dry sand molds. The core benches extend along the wall and columns of the building and cores have to be carried to the cars which are shown standing outside of the ovens.

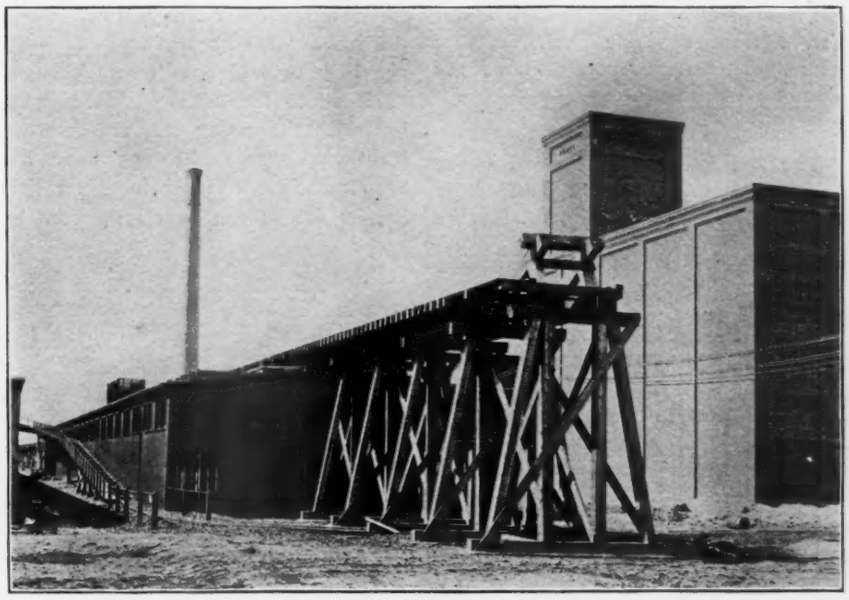


FIG. 6—SWITCH-BACK FROM THE CUPOLA CHARGING FLOOR. STORAGE BINS ARE ALSO SHOWN

Brass Foundry.

The brass foundry is in the northwest corner of the side bay and occupies a space 120 x 40 feet. In addition it has a store room 20 x 40 feet. Two 3-ton Niles cranes with electric hoists serve the entire floor. The melting equipment of the brass foundry comprises 16 coke-fired crucible furnaces. These are furnished natural draft by a stack 24 inches diameter and 100 feet high. Molding is done on four Tabor molding machines, installed opposite the crucible furnaces. The total capacity of the brass foundry is about three tons daily.

Rattling Room.

All castings are tumbled in the rattling room, a separate building 116 x 42 feet, located south of and parallel to the foundry. Six rattling machines

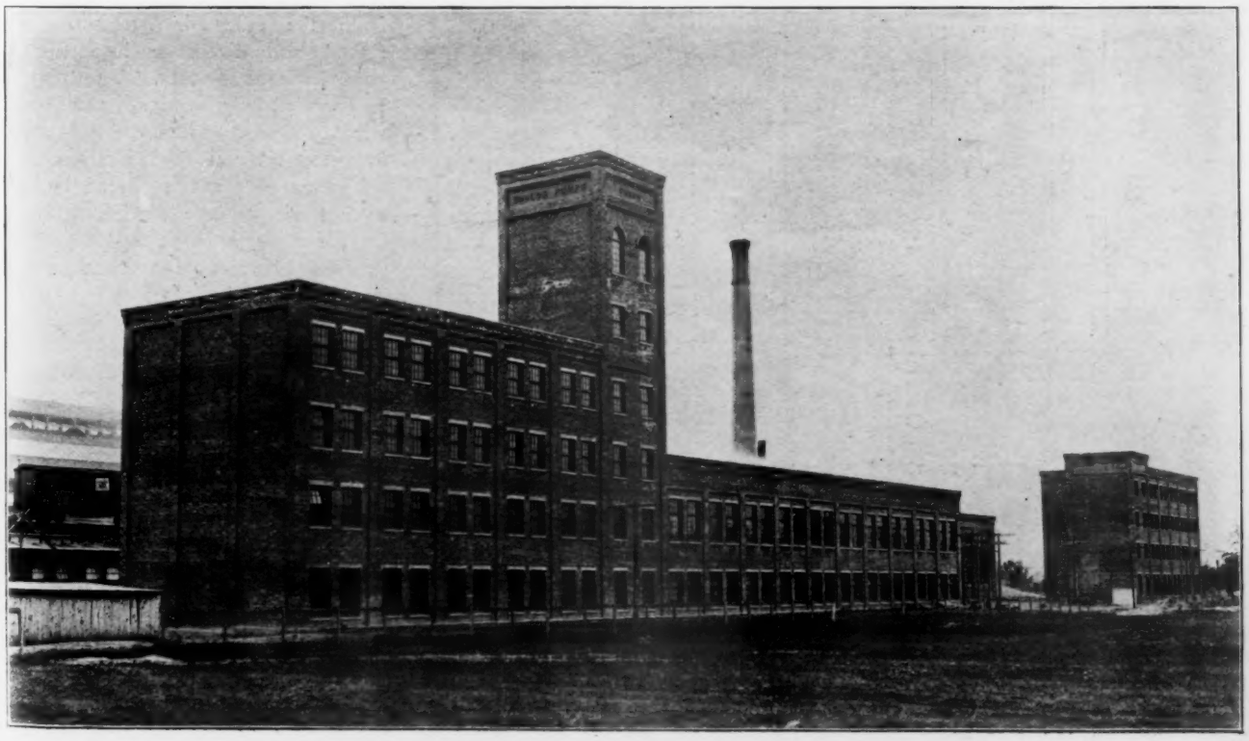


FIG. 7—PATTERN SHOP AND PATTERN STORAGE BUILDINGS

are installed in this building, motor driven from a single shaft by spur gears. This room also contains the grinding machinery.

Storage Bins.

The storage bins are located in the corrugated iron structure built under the trestle, shown in Fig. 6. At the far end this trestle also spans the coal boxes of the power plant. The storage building is divided into a number of bins and a hatchway is let into the roof above each bin through which sand, coke, pig iron, etc., can be dumped from the cars directly into the bins. The space under the trestle and beyond the storage building may also be used as a pig iron yard.

An industrial railway runs along the inside of both walls of the storage building and another track crosses it about the middle. The system by which the empty cars are returned from the cupola charging floor has been mentioned earlier in this article but its details can be clearly seen by reference to Fig. 6. A portion of the dead end switch-back is at the right foreground of the picture and the two lines leading from this switch-back into the storage building are clearly shown.

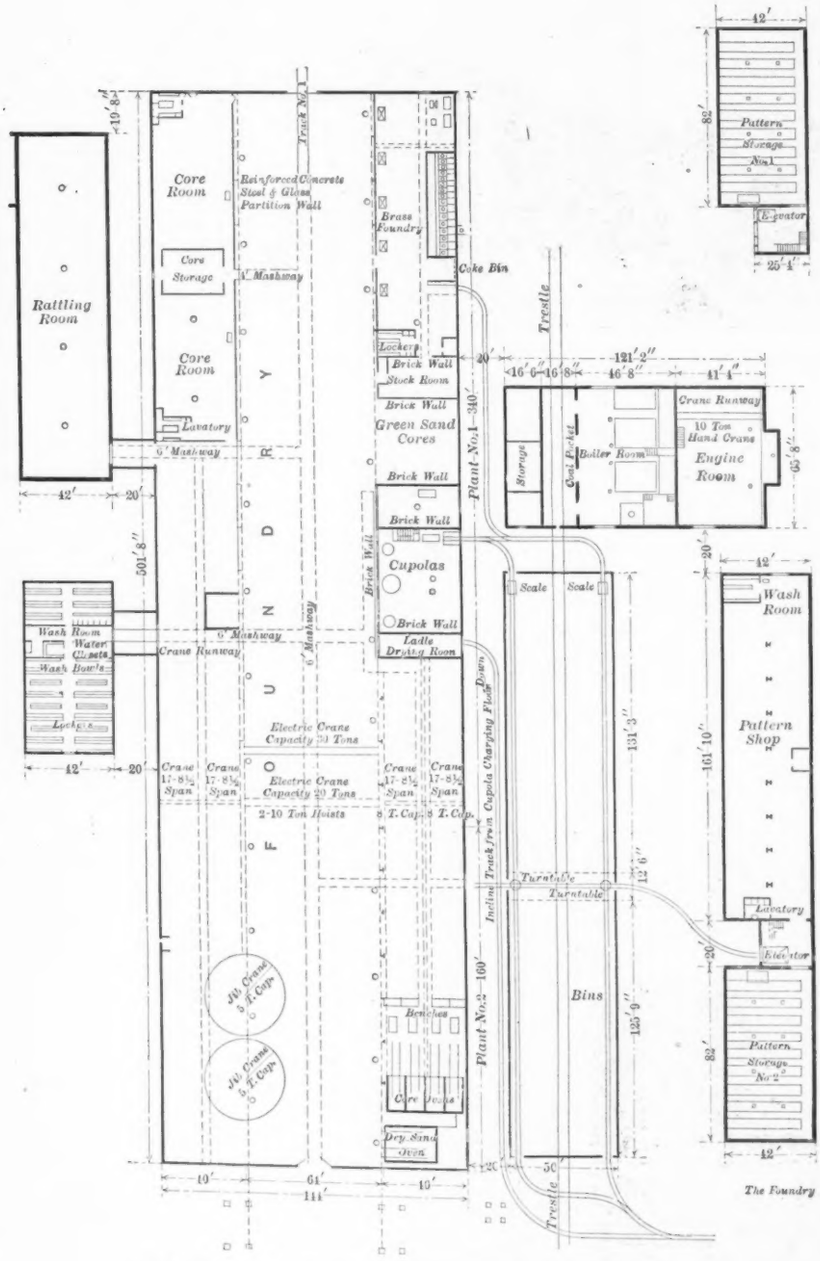


FIG. 8—LAYOUT OF THE FOUNDRY OF THE GOULDS MFG. CO.

An industrial railway runs along the inside of both walls of the storage building and another track crosses it about the middle. The system by which the empty cars are returned from the cupola charging floor has been mentioned earlier in this article but its details can be clearly seen by reference to Fig. 6. A portion of the dead end switch-back is at the right foreground of the picture and the two lines leading from this switch-back into the storage building are clearly shown.

Pattern Storage.

Two pattern storage buildings have been erected as shown in Fig. 7. These are of heavy mill construction, four stories in height, and have windows only on the side away from the plant, which faces on a street. Adjoining the pattern storage building is a two-story pattern shop and the stair tower, containing at the top a 33,000-gallon fire service water tank for providing pressure for the automatic sprinklers and it also provides a reserve to the city supply. Additional reserve is secured by means of a reservoir located in the field opposite the pattern storage.

Power Plant.

A new power plant has been erected to provide power not only for the foundry but for the machine shop and other buildings. It contains three Babcock & Wilcox 150-horsepower hand-fired boilers. These furnish steam for two Allis-Chalmers simple non-condensing engines, one of which is direct-connected to a 300-kilowatt 250-volt generator, delivering current on the three-wire system. The other engine is belted to a 150-kilowatt Westinghouse generator of the same type as the large one. Space has been reserved for the duplication of the engine equipment. The switchboard is located in a separate bay 24 x 6 feet on the north side of the engine room. A 10-ton hand crane spans the engine room for convenience in handling repair parts. In the basement two Underwriter's fire pumps are installed of 1,000 and 750 gallons per minute capacity respectively. These pumps receive water from the reservoir heretofore mentioned and discharge into the mill yard hydrant system. The reservoir is supplied with water by a Gould's triplex power pump taking suction from the river, 1,700 feet distant.

The entire plant is heated by means of hot air on the American Blower Co.'s system, exhaust steam from the engines being used to heat the air which is forced through pipes to various parts of the foundry by blowers located at various points.

CINCINNATI ASSOCIATED FOUNDRY FOREMEN.

The Associated Foundry Foremen of Cincinnati held their holiday meeting on the evening of Dec. 28. President C. H. Thomas, of the Model Foundry Co., Oakley, in which several important local firms are interested, presided at the meeting which followed the usual dinner. Prof. John J. Porter, of the University of Cincinnati, addressed the members on the subject of "Direct Castings from Blast Furnace Metal," and James A.

Murphy, foreman of the Hooven-Owens-Rentschler Co.'s foundry at Hamilton, O., spoke on "The Jobbing Foundry." It was reported that Cincinnati may secure the 1909 meeting of the national organization, which this year goes to Toronto, Canada. It was decided to hold an early meeting of the Cincinnati association in Dayton, where John A. Logan, foundry superintendent of the National Cash Register Co., and a member of the Cincinnati local, will make all arrangements. An illustrated lecture on a new molding machine for complicated and special work was arranged for the next meeting, Jan. 25.

HANDLING IRON IN THE FOUNDRY.

At the regular monthly meeting of the Chicago Associated Foundry Foremen's Association held Saturday, Jan. 11, at the Lewis Institute, Chicago, Eugene W. Smith read a paper entitled "The Various Methods of Iron Conveyance in the Foundry." He said that the rapid development of the molding machine and various devices for increasing the output of foundries has necessitated a corresponding increase in the speed of melting and handling the iron. Continuing, the speaker said:

The first device of which I have any recollection was an ordinary ladle on trunnions, some of which may still be in use. This device required clear gangways and uniform heights of molds and pouring was done direct from the ladle. The advancement since then has been very rapid.

Another system provides for the use of a larger ladle arranged on trunnions and run on tracks in the floor with turntables at crossings, the iron being conveyed from the cupola to the floors and poured into smaller ladles. This system, except for very heavy work and where iron is very fluid, I do not consider very good, as the delivery of iron is apt to be very slow and unwieldy, entailing too much waste from chilling.

There are a great many systems of overhead trolleys in use but great care should be exercised in choosing the system to install. If the work is heavy and the system will be subjected to heavy loads, there are several on the market of heavy steel construction that will give good service.

For this class of work it is advisable to consider the installation of the electric overhead traveler, assuming that the cupola is conveniently located. For general light work where ordinary 150-pound ladles are used, I favor any of the various light trolley systems.

In this connection I would like to mention several of the most important factors to be considered. The tracks should be smooth and as level as possible. If any incline is needed it should be in the direction the load is to be carried. If possible they should be free from switches and short curves. The wheels should be true and as light running as possible. As few ladles as possible should be run in any one direction and the delivery should be very rapid.

In the past I had occasion to time the speed of one system and I found that a man could run 150 feet and serve four smaller ladles on the floor and return to the cupola in 1½ minutes.

Under all circumstances speed and safety should be the first consideration. The light running overhead trolley systems I consider the best where distance is to be covered and the work is light and particularly so if hard iron is required. The cost of installation is not great and will soon pay for itself no matter what the size of the heats.

With the light running trolley system and quick delivery, four men running 180-pound ladles should easily handle 8 tons per hour. Compare the up-to-date foundry with modern conveying systems for iron, where molders are paid for their knowledge of molding and not for their physical prowess, with the old time arrangement where men have done their regular day's task and, if it has been a good one, they are forced to face in the latter part of the day the task of lugging a large quantity of iron for several hours through the heat and dirt and smoke, and when this is over lie down outside of the shop on an old bottom board or rush off to the nearest "refreshment parlor," unfitting themselves for the next day's task.

With up-to-date methods it is no longer necessary that such conditions should prevail and there is no good reason why any molder should not leave his shop the equal of any other mechanic in his appearance, or be as well prepared to enjoy his evening at home.

If for no other reason than its humane feature, no foundry should be without some system of conveying the iron mechanically and no matter what system is installed it is essential that the iron be delivered to any part of the shop in the very best possible condition.

PHILADELPHIA FOUNDRY FOREMEN.

A large number of apprentices from the foundries in Philadelphia and vicinity attended the monthly meeting of the Philadelphia Foundry Foremen held on Jan. 13, at Dental Hall, Philadelphia. The apprentices were addressed by J. Sherwood Rooke, instructor in mechanical drawing at the Spring Garden institute. He discussed the education of apprentices in work shops and impressed upon the boys the importance of embracing every opportunity for utilizing their spare time for educational purposes. He pointed out that sacrifices must necessarily be made to gain high positions in any trade or profession, but the results in later years amply repay any efforts that have been made. Among other things he said that the time spent in the foundry is to some their school of instruction and he impressed on the apprentices the importance of devoting all this time to the work at which they are engaged. Attention was also directed to the importance of good reading matter.

USE OF ANTIMONY.

By J. F. Buchanan

Small additions of antimony give increased hardness and elasticity to aluminum, and many of the modern alloys have antimony up to 2 per cent. A very strong, hard, close-grained alloy is made with copper, 66 per cent; nickel, 24 per cent, and aluminum, 10 per cent. When polished, this alloy has the color of 10 karat gold, and in alloying, the aluminum is put into the crucible after the other metals have become liquid.

MALLEABLE SCRAP.

By W. J. Keep

Question:—We have more malleable scrap on hand than we can successfully use, consisting of couplers, post brackets, brake wheels, brake brackets, and a lot of other car and engine parts. Our heats average 8 to 10 tons daily and we use very little scrap in our mixture. We would like to know how we could use up these malleables.

Answer:—It is generally understood that malleable scrap cannot be used for gray iron castings, but I would be tempted to add ferro-silicon until the iron is soft and then pour it into work that it would be best adapted for.

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CONTENTS.

Production of Malleable Castings... 257
Pneumatic Charging Machine for Malleable Furnaces 260
Growth of the Malleable Iron Industry 262
Molding a Large Cylinder Casting.. 265
Machine Molded Drop Hangers.... 267
Cost Finding 269
Chicago Associated Foundry Foremen's Exhibit 272
Limitations of the Molding Machine. 273
A Method of Molding a Web Pulley 276
A Few Pattern Shop Sanding Schemes 278
Organization of the Pattern Shop.. 281
Blow Holes and Gases in Cast Iron 284
The Jobbing Brass Foundry—IV... 285
Use of Cothias Metal for Castings.. 287
Drawing Board 288
Alloys for Railroad Bearings..... 289
Use of Borings for Annealing Scale 291
Melting Brass on a Forge..... 292
Action of Acids on Aluminum Alloys 292
Melting Nickel in a Brass Furnace.. 292
Dross Difficulties 293
Casting Nickel 293
A Model Gray Iron Foundry..... 294
Handling Iron in the Foundry..... 299
Philadelphia Foundry Foremen..... 299
Trade Outlook 300
Obituary 301
Personal 301
Melting Cast Iron Borings in the Cupola 301
Revolving Oil Stone Edge Tool Grinder 302
Ladle Dauber 303
Modern Core Oven..... 304
Malleable Furnace Grate..... 305
General Industrial Notes..... 307

Trade Outlook

While foundry trade conditions did not materially improve during January, nevertheless the gray iron jobbing shops report considerable repair work from inoperative plants that are preparing to resume operations. A slightly improved demand is also noted for malleable castings, a number of idle works having resumed during the month. There is little demand for steel castings and prices are declining. Pig iron quotations have dropped to a basis of $12, Birmingham, for No. 2, and $16 has been asked in the Mahoning and Shenango valleys for northern grades. Owing to the increased cost of making southern iron it is doubtful if prices will recede further, although the disagreement among northern operators at Youngstown recently may foreshadow further concessions. Buying is for immediate requirements only, and the large contracts recently placed were closed to cover sales of cast iron pipe for spring delivery. From figures now available it is estimated that the country's pig iron production during 1907 reached a total of 25,750,000 tons, an increase over the previous year of 450,000 tons. Had there not been the sudden slowing down during the closing months of last year, the gain would have been at least 2,000,000 tons.

Malleable Cast Iron in 1907

The malleable industry has recorded greater growth in recent years than any other branch of the foundry trade. The production, which last year reached a total of 969,399 tons, is second only to the output of gray iron sections and is several hundred thousand tons greater than the yearly production of steel castings. This phenomenal development is the more remarkable in view of the rapid substitution of railroad parts by rolled and cast steel sections. Within 18 months no less than 13 new plants have become operative, and the producing capacity will be still further increased when the four new works under erection are completed. The extensive use of cupolas for melting iron for malleable purposes is surprising, 42 furnaces of this type being operated. Their total production is small, however, and is considerably less than that of the 21 open-hearth furnaces. That air furnaces, with all their imperfections, are preferred is shown by the preponderance of this type. Additions to the melting capacities of existing plants during the year have been unusually heavy and the tendency is towards larger furnaces rather than an increase in the number of smaller ones. The use of molding machines has been a factor in increasing the number of heats per day and the general efficiency of these works has been raised by the installation of this labor-saving equipment. In the compilation of these statistics great care was exercised to secure data representative of actual operations, and with only a few exceptions, the manufacturers generously furnished all of the necessary information requested.

Prize Contest Awards in March

Announcement of the awards in the prize contest conducted by THE FOUNDRY has been deferred one month. The March issue will therefore contain the four prize winning articles, as well as several of the others that were submitted. The careful consideration of the mass of manuscript received from practically every civilized country in the world involved a tremendous amount of work and so many novel methods, short cuts and kinks were described that the task of making the awards is a difficult one. Several articles have been received from Australia and European foundry practice has been touched upon by several authors. The articles accepted, and not sharing in the prize distribution, will be published in the next few months. The prize contest has proved so successful that it will hereafter be made an annual feature.

Personal Association

Little does a young man realize how he is judged by the company he keeps, how he displays in his own character the type of his associates. We are apt to think only of the moral aspect of the question, but the intellectual influence is equally strong in determining character and ability. Let any one keep careful record for a single week of the way in which his waking hours are spent. Unless he is still a student, or an exception to the rule, he will be greatly surprised to discover what a very small portion of his time is definitely devoted to intellectual advancement. He need not classify study or reading alone under this heading. The mental uplift of conversation with cultured or ambitious, thinking associates is also to be measured at full value. It may not be easy to follow Edward Everett Hale's advice, to at least once a day talk with some one who is your superior; it may be hard

on the superior, but the motive should be fostered. There are hours aside from work or pleasure that should mark intellectual advancement. They may be devoted to the friendship of good books, or of good men and women, but friends there should be, for the human element in their influence must not be overlooked. It should be recognized as the best that goes to make life worth living.

PERSONAL.

J. C. Miller, formerly sales agent of the Columbus Iron & Steel Co., Columbus, manufacturer of Bessemer, basic, malleable and foundry iron, has been elected secretary of that concern.

Walter B. Snow, Boston, formerly president of the New England Foundrymen's Association, now engaged in independent practice as publicity engineer, has been elected an honorary member of that organization.

A. L. Roberts, associated with the Morgan Engineering Co., Alliance, O., for 18 years, has been appointed mechanical and designing engineer for Pawling & Harnischfeger, manufacturers of traveling cranes.

W. H. McFadden, vice president and general manager of the Mackintosh-Hemphill Co., Pittsburg, has returned from a European tour.

A. A. Holmes, formerly mechanical engineer for the U. S. Brick Co., Reading, Pa., has been elected president of the Hancock-Holmes Foundry & Machine Co., Atlanta, Ga., recently organized.

J. F. Gaffney, manager of the Toronto, Canada, branch of the Dominion Foundry Supply Co., during the last two years, has resigned to accept the position of superintendent of the John McDougall Caledonian Iron Works Co., Montreal, Canada. Mr. Gaffney was formerly foundry superintendent of the Allis-Chalmers-Bullock Co.

Richard Moldenke, secretary of the American Foundrymen's Association, Watchung, N. J., has been appointed a member of the board of managers of the New Jersey State Charitable Institutions, by Governor Stokes.

OBITUARY.

Alexander W. Slocum, a well known car wheel foundryman, died at his home in Pittsburg, Dec. 31, at the age of 44. Mr. Slocum was born in New York and completed his education in Columbia University and was later connected with many large car wheel manufacturers in this country and Europe. In 1896 he was sent by a Buffalo company to erect and put in operation a car wheel plant at Budapest, Austria, and one at Leobras, Germany. He was instrumental in founding and developing the Pennsylvania Car Wheel Co., of McKees Rocks, Pa., afterward absorbed by the Schoen Pressed Steel Car Co. He was one of the promotors of the Keystone Car Wheel Co., which later became the National Car Wheel Co., Pittsburg. In 1906, he was employed by the Dickson Car Wheel Co., Houston, Tex., to build its new car wheel foundry, which he completed about 60 days before his death. Mr. Slocum was a member and former president of the Pittsburg Foundrymen's Association, a member of the Engineers' Society of Western Pennsylvania and other organizations.

Isaac Reese, a pioneer iron manufacturer and later identified with the fire brick industry, died Jan. 1, at his home in Pittsburg, as the result of a fall from a street car a few weeks before. Mr. Reese was 87 years of age. His family came to this country from Wales in 1832 and settled in Pittsburg, where his father, William Reese, became a prominent iron manufacturer. His sons, Isaac and Jacob, were associated with him in the building of blast furnaces. Later, Isaac Reese took up the manufacture of fire brick under the firm name of Isaac Reese & Sons, and established plants at Osceola Mills, Manorville and Kittaning, Pa. When the consolidation of various brick interests was effected several years ago, Mr. Reese retired from active business life.

MELTING CAST IRON BORINGS IN THE CUPOLA.

By T. Shaw

In answer to the inquiry made in the January issue of The Foundry, regarding the best method of melting cast iron borings in the cupola, I have a suggestion to offer that has given me excellent results in the past. When charging the cupola, I usually lay about 200 pounds of small scrap evenly on the bed of coke, and on top of this layer I charge from 100 to 200 pounds of borings. I then complete the charging of the furnace in the usual way, the weight of the pig iron being sufficient to prevent the borings from being blown out of the stack. Some of the borings are, of course, lost in this way, but the speed of the blower can be regulated and the blast can be kept down to eight or ten ounces.

Before bedding in the last two charges, it is advisable to reduce the speed of the blower about one-half, as the greatest loss will occur at this time, if the furnace is not properly controlled.

Another method that has given good results provides for the charging of the borings when the furnace is running low and after the molds have all been poured. The entire charge of borings can be made, amounting to 2,000 pounds, and can be melted with a small amount of coke, as the furnace is hot enough at this time to almost melt these small particles of iron. This iron will be suitable to run in the pig bed. The borings can also be thrown onto the pigs while still in a molten state, and it will be found that a considerable quantity will be absorbed and held in this way.

OBERMAYER BULLETIN.

The January number of the *Obermayer Bulletin*, issued by the S. Obermayer Co., Cincinnati, manufacturer of foundry supplies, among other interesting features contains a description of the Rillton facing mill operated by this concern. The manufacture of sea coal is outlined in this article, which is printed on an insert of heavy coated paper. The new illuminated cover, portraying the pouring of a large casting, immeasurably adds to the attractiveness of the *Bulletin*.

CLEVELAND ASSOCIATED FOUNDRY FOREMEN.

At the meeting of the Cleveland Associated Foundry Foremen held at the American House, Cleveland, Saturday, Jan. 20, J. S. Smith of the J. D. Smith Foundry Supply Co., was elected secretary and treasurer to succeed Henry M. Lane. Hugh McKenzie was re-elected president, and L. Bernard, first vice president. Mr. Smith will make an earnest effort to rejuvenate the organization and the special program outlined for the February meeting will undoubtedly result in a large attendance.

STATUARY AND TABLET BRONZE.

By C. Vickers

Question:—Kindly give us the best mixtures for statuary bronze and tablets.

Answer:—The United States standard statuary alloy follows: Copper, 90 pounds; zinc, 7 pounds; tin, 3 pounds; lead, 8 ounces. The alloy used by Bureau Bros. from the early sixties to some time in the eighties consisted of copper, 90 pounds; zinc, 5 pounds; tin, 5 pounds, and lead, 8 ounces.

FOUNDRY & PATTERN SHOP EQUIPMENT

Revolving Oil Stone Tool Grinder—Ladle Dauber —Modern Core Oven—Malleable Furnace Grate

THE REVOLVING oil stone universal tool grinder designed for use in pattern shops and woodworking establishments, shown in the accompanying illustrations, is manufactured by the Mummert, Wolf & Dixon Co., Hanover, Pa. Several advantages are claimed for this machine, in that it can be used for grinding long knives and for sharpening all kinds of edge tools. The grinder, instead of being equipped with the ordinary emery wheels, has oil stones mounted on its arbor. One is comparatively coarse grained for fast grinding, and the other has a finer grain for giving the knife a smooth, keen edge. Fig. 1 shows a rear view of the machine and Fig. 2 a front view, with the knife grinding atttachment removed.

The arbor carries two oil stones. On the end of the main spindle is a grinding cone for sharpening pattermakers' gouges, and at the back, as shown in Fig. 1, is a small grinding wheel for general light grinding. The wheel arbor is driven by a belt from a driving shaft mounted on a base at right angles with the arbor and an idler pulley serves to take up the stretch of the belt.

The pulleys are located at the rear, which keeps the driving belt out of the way, and it can be conveniently run to an overhead shaft or one below the floor. The knife grinding attachment is automatic and has a strong and rigid knife bar so that the knife can be easily attached and removed. The bar is adjustable so that either an acute or blunt angle may be ground and the attachment is swiveled at the center to permit bringing the work in contact with either of the wheels. These attachments are made for 30, 40 and 50-inch knives. To remove the attachment requires little effort, as hand screws are provided for holding the device. For this reason this attachment can be applied only as required.

Before starting the machine it is advisable to have the oil stone wheels thoroughly saturated with kerosene. The wheels rapidly absorb the oil and when not in operation appear to be dry, but when running at a high speed the centrifugal force causes the oil to work to the surface. It is not thrown off, however, on account of the adhesion of the oil to the stone.

The oil serves two purposes. By keeping the surface of the wheels moist it prevents the tool from heating and the surface of the stones is kept clean and sharp and glazing is prevented. After the stones have been saturated, it is only necessary to apply a few drops of oil occasionally.

The regular equipment of the grinder includes two oil stone wheels 8 inches in diameter by 2 inch face, one grinding cone 3 inches in diameter by 5 inches long and one grinding wheel 3 inches in diameter by 3-16 inch thick. The tight and loose pulleys are 6 inches in diameter by 2 inch face and are intended to be run at 260 revolutions per minute.

FIG. 1—REAR VIEW OF REVOLVING OIL STONE EDGE TOOL GRINDER

DAILY CUPOLA RECORDS.

It is generally recognized by successful manufacturers that next in importance to the choice of foundry apparatus is its proper adaptation. Much modern equipment would give better results if more attention were given to its application. To know at all times the work that is being accomplished by the blower and cupola, careful records should be kept of all material used, of the operating conditions and the resultant metal. These records will show whether or not the equipment is adapted to the work.

The B. F. Sturtevant Co., Hyde Park, Mass., realizing the value of these records, has prepared a daily cupola report attractively printed on card stock that provides a form for recording all necessary data and is a convenient means for preserving a permanent record. Each report covers a period of one month and the February form will be sent to any foundry on request.

The report contains spaces for the various grades of pig iron and scrap charged, the amount of coke and limestone consumed, the total metal, the weight of sprues, pig bed, etc., average pressure, the time when the blast was applied, bottom dropped, dead heap, the total number of good castings, and the percentage of good castings in the melt.

In summarizing the cupola test, the following information is desired: Size and make of cupola, together with the diameter inside of the lining, number of tuyeres, height of the charging door, above the tuyeres, type of blower and method of driving, kind of fuel, weight of first charge of fuel and iron in pounds and succeeding charges of fuel and iron, the time when the fire was started, blast on and bottom dropped, kind of iron used, ratio of scrap to pig and metal to fuel, total iron, coke and limestone charged in pounds, average revolutions per minute of blower, average and maximum blast pressures in ounces, maximum air in cubic feet per minute, maximum hundred horsepower to blower, ratio of melting, volume of air per ton of iron per hour, and the duration of the heat.

LADLE DAUBER.

The machine shown in the accompanying illustration is designed for daubing or lining ladles with sand or clay and is intended to obviate the necessity of daubing these ladles by hand, which entails considerable work. After the old linings have been knocked out of the ladles and after the amount of mud required to daub them is placed inside, the ladle is placed on the machine and is clamped in a rigid position. The plunger is then released and all of the excess mud is forced out through a small space left between the ladle and the plunger. The plunger is designed to shape the lining around the top of the ladle and no further lining of the ladle is required after it leaves the machine. The downward movement of the plunger can be regulated within required limits according to the size of the ladle.

By the use of this machine it is impossible to daub the ladle unevenly and consequently, there are no irregularities in the amount of metal that a ladle will hold, which causes so much annoyance to molders. The ladle dauber can be connected with any available power or can be driven by an independent motor. It requires about as much space as an ordinary drill press and has been designed and is being built by Charles Bartholomai, W. G. Stockham, and G. R. Deming, Piqua, O.

LADLE DAUBER

THE PROGRESSIVE SPIRIT.

The S. Obermayer Co., Cincinnati, manufacturer of foundry supplies, is enclosing two cards with its correspondence that contain pertinent suggestions which, if followed, will greatly aid in restoring confidence and will insure the return of the circulating medium to its proper channels. The first reads as follows:

"In sending you the enclosed check for our account, we do so with the hope that you will immediately continue it on its way to do its full share in restoring confidence and prosperity for us all. The spirit of patriotic cooperation should govern us all at this time—the most practical method is first to pay the bills we owe. American merchants and manufacturers have never been found wanting in a patriotic emergency. Put your shoulder to the wheel with the rest of us—NOW."

The second, designed to reach the man who signs the checks, is given below:

"The spirit of patriotic financial cooperation should govern us all at this time—the most practical method is for us to pay each other the bills we owe. We are doing what we can in that direction. Will you help us?

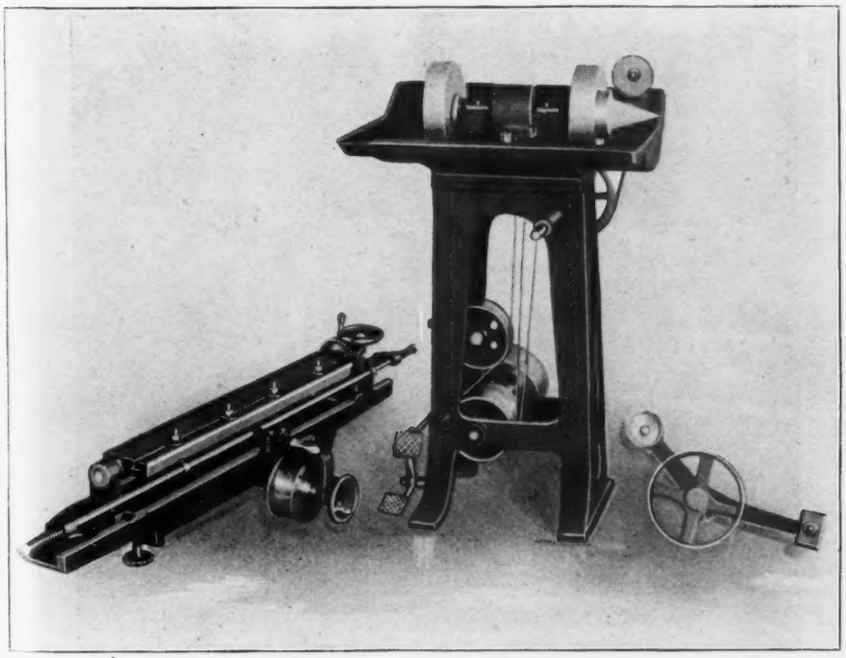


FIG. 2—FRONT VIEW OF REVOLVING OIL STONE EDGE TOOL GRINDER WITH KNIFE GRINDING ATTACHMENT REMOVED

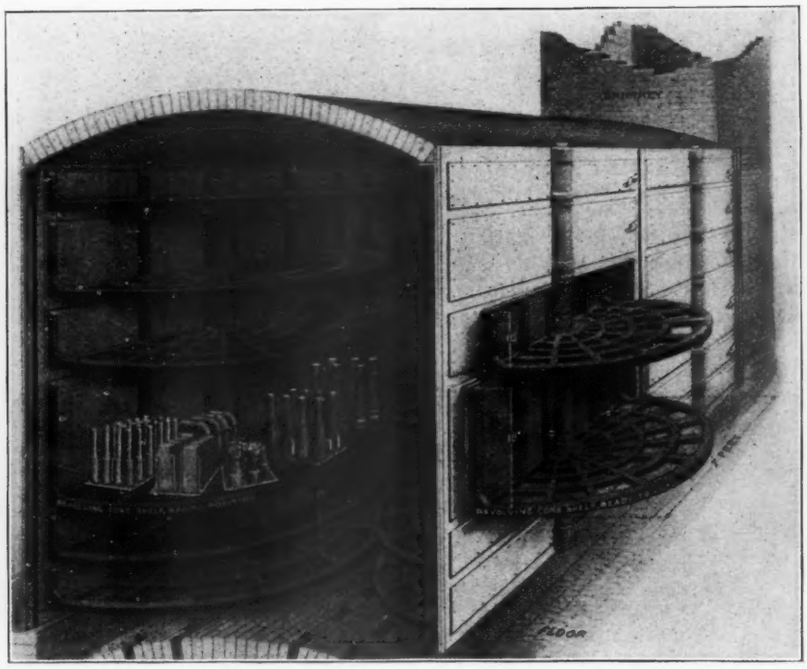


FIG. 1—INTERIOR VIEW OF MODERN CORE OVEN SHOWING ARRANGEMENT OF SHELVES

We will promise to start your remittance on its way immediately upon receipt to do its full share in restoring confidence and prosperity for us all."

THE MODERN CORE OVEN.

The heat for drying the cores in the oven shown in Figs. 1 and 2 is admitted from the fire box underneath it, through numerous small openings in the brick floor arched over the fire box and underneath the nest of revolving core shelves. In this way the temperature is evenly maintained throughout the baking chamber and the cores are uniformly baked.

The shelves or reels are half circles instead of quadrants, which practically double the baking capacity of the oven and permit the handling of work up to 6 feet long. Each section also contains shelves of various sizes up to 6 feet long to accommodate a wide range of different sizes of cores. The shelves are closed automatically when opened for loading, as shown in Fig. 1, which prevents the cooling of the oven. The ovens are of heavy steel construction and are made up in sections 7 feet square to form any length of oven required. An oven 28 feet long and 7 feet wide will easily serve from 50 to 75 coremakers on ordinary work. The oven is built by the Buffalo Furnace Works, Buffalo.

NEW METALLURGICAL PLANT.

George G. Blackwell Sons & Co., Ltd., Liverpool, England, have erected at Garston a new metallurgical plant for the manufacture of alloys and the rarer metals. This applies especially to tungsten, for the steel trade. Garston is a suburb of Liverpool, and the company's works are located adjacent to the Garston docks, and also to the L. & N. W. and Midland railways. Facilities for handling the supply of ores and the forwarding of alloys and metals are therefore both economic and convenient. Before this plant was built, England relied chiefly for its supply of tungsten upon importations from Germany. The tungsten manufactured by this concern is guaranteed to contain from 96 to 98 per cent of tungsten, and is practically free from carbon and other deleterious matter. This concern has also made extensive experiments with molybdenum and is supplying the trade with this metal in the form of molybdenum metal powder and ferro-molybdenum, containing respectively 50 and 80 per cent of molybdenum.

MALLEABLE FURNACE GRATE.

One important feature of the malleable furnace grate shown in the accompanying illustration, manufactured by the Cyclone Grate Bar Co., Buffalo, consists of its rocking movement, insuring a clean fire and a free distribution of air. The fire can also be dropped when necessary and a new fire can be built before the temperature of the furnace has been materially reduced. The grate designed for malleable iron practice is made up of bars ranging in length from 18 to 30 inches, having a width across the top or face of 11½ inches. These sections set crosswise in their independent frame, which is supported in the brick work of the furnace. The bars are double trussed lengthwise, as

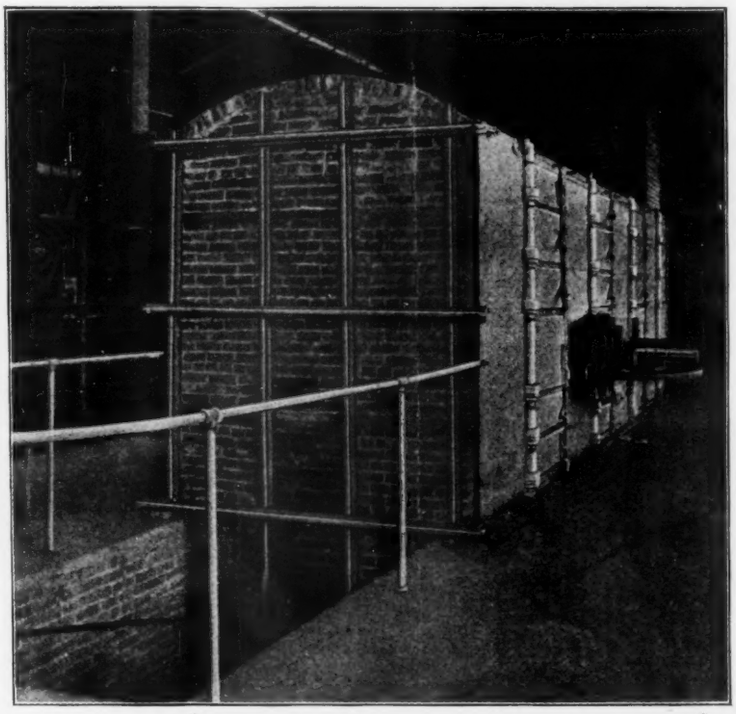


FIG. 2—MODERN CORE OVEN SHOWING FIRING PIT

shown in Fig. 2, with clips running across them. The trusses and the clips are cast solid. The clips on the face are usually ⅝-inch and the air space between them is of equal size. The grates, however, have been built with ¾-inch clips and air spaces 1⅛ inches between them. The design in this respect depends entirely upon the fuel which is to be used.

The clips taper from the face of the grate to the under side which enlarges the air space to twice the capacity underneath as compared with that of its upper face. When shaken, the grate can be rocked up and down 5 inches without opening the space between the bars, which remains at ⅝-inch during the rocking movement, thus preventing the dropping and wasting of unburned fuel. The bar also has a backward and forward movement of 1½ inches, which shakes the ashes off the bottom without disturbing the fuel bed. When turned to the dumping position a space of 7 inches is opened between the bars and the entire residue of the fuel is precipitated into the ash pit without coming in contact with any of the operating parts of the grate.

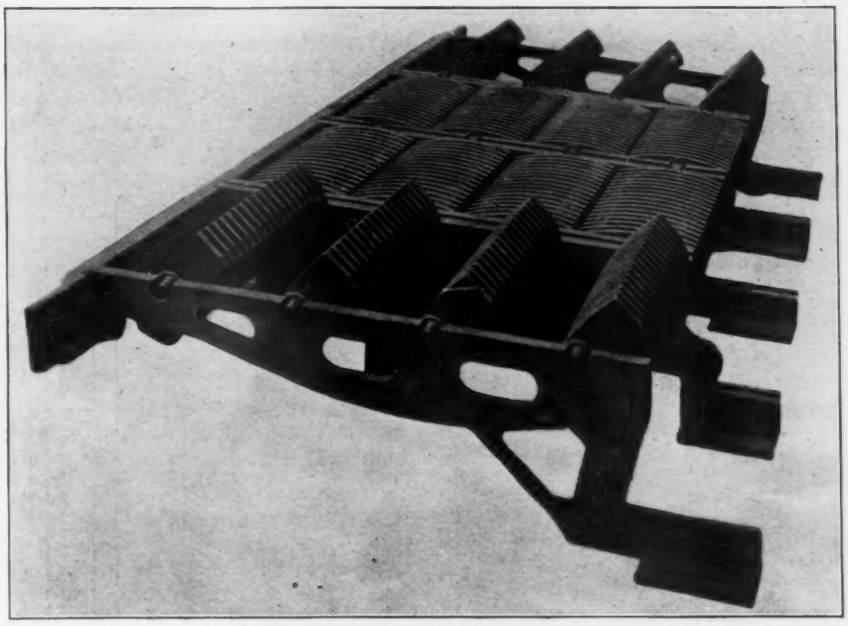


FIG. 1—CYCLONE MALLEABLE FURNACE GRATE

TRADE NOTES.

The Alaska Graphite Co., Oakland, Cal., recently delivered its first shipment of graphite from its mines in the Port Clarence district of Alaska. The deposits are extensive, and the graphite is unusually well adapted for foundry work. The property will

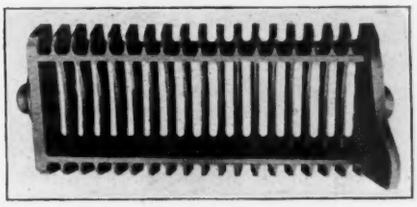


FIG. 2—CYCLONE GRATE BAR

be worked on an extensive scale this year.

The Northern Engineering Works, Detroit, Mich., has recently installed Newten cupolas in the plants of the L. H. Goodnow Co., Fitchburg, Mass., and the Seattle Car Manufacturing Co., Youngstown, Wash.

Geo. F. Crivel & Co., Buffalo, dealers in foundry supplies and equipment, report their first year's trade as highly satisfactory. A large number of contracts have recently been closed and indications point to a greatly increased trade during 1908.

The E. H. Mumford Co., Philadelphia, has acquired all patent rights and molding machines and equipment of Ph. Bonvillain & E. Ronceray in the United States. The offices of the E. H. Mumford Co. will be removed from Seventh and Callow Hill streets to 1315 Race street, where the French machines have been installed as a working exhibit.

The Philadelphia Tramrail Co., 1009 Drexel building, Philadelphia, manufacturer of overhead tramrails and conveying systems, has been organized by Charles B. Leonard, Harry B. Russell and C. H. Fries. The latter was formerly with the Moyer Tramrail Co., and is now acting in the capacity of sales agent for this concern.

The Bristol Co., Waterbury, Conn., has been awarded a silver medal for its recording instruments exhibited at the Jamestown exposition.

An exceedingly attractive calendar, showing the Matinee Girl in all her resplendent glory, is being sent to the trade by the Western Foundry Supply Co., manufacturer of ferro-alloys, facings, foundry supplies, etc., 99 John street, New York, and East St. Louis, Ill.

The brass foundry heretofore operated by Miles Sweeny at 73 Hamilton street, Newark, N. J., has been purchased by Charles Redlinghouse, who has made several improvements to the plant. These include the installation of a new core oven designed and built by E. E. Steiner, of Newark.

The Debevoise-Anderson Co., selling agents for pig iron, coal, coke and other foundry supplies, with offices at 95 Liberty street, New York, has taken the exclusive eastern sales agency for the products of the Midvale Mining & Mfg. Co., St. Louis. These include prepared ferro-manganese, ferro-silicon, silico-manganese and a special preparation known as carbonese. The Midvale company has been supplying these products to the foundry trade for more than ten years.

The E. B. Van Wagner Mfg. Co., Syracuse, N. Y., recently incorporated, manufactures finished metal castings from alloys especially prepared by it. Charles Van Wagner, who is president and actively interested in the company, was for 25 years the senior partner of the Empire Metal Co., Syracuse, but sold his interest in the latter last May. The Empire Metal Co. manufactured babbitt metal and all grades of metal alloys and produced the metal used by the H. H. Franklin Mfg. Co. in its die castings and known as Franklin metal. Mr. Van Wagner is now giving his entire attention to producing new and improved alloys, which the company is offering to the trade.

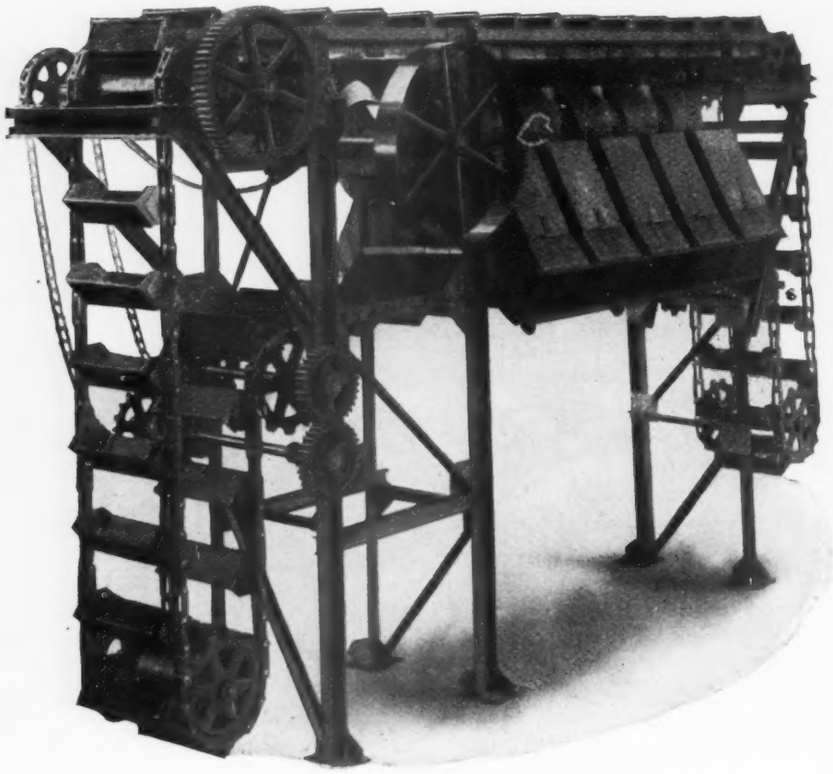
The Dayton Malleable Iron Co., Dayton, O., has added a three-motor electric traveling crane, having a 35-foot span. The crane runway, as well as the crane, were furnished by the Northern Engineering Works, Detroit.

The Northern Engineering Works, Detroit, has recently installed a No. 54 Newten cupola in the plant of the Standard Pulley Co., Cincinnati. Cupolas have also recently been shipped to Havre, France, and Genoa, Italy.

C. W. Hill & Co., 201 Woodward building, Birmingham, Ala., have been appointed special representatives for the southern states for Pawling & Harnischfeger, Milwaukee, builders of traveling cranes and horizontal drilling and boring machines.

FOUNDRY ELEVATING AND SCREENING MACHINE.

The Stephens-Adamson Mfg. Co., Aurora, Ill., recently designed and built for a steel foundry the machine shown in the accompanying illustration. It is a device intended to effect a large saving in labor as applied to the elevating and screening of sand used in large molding machines. In outline it is an endless chain bucket elevator and conveyor by which the sand is scooped from the pile on the floor and raised into a series of hoppers ready for use as required, having been screened in the meantime. For this operation only one attendant is necessary and the control of the entire machine is easily accomplished by him.



FOUNDRY ELEVATING AND SCREENING MACHINE

The buckets are 12 x 24-inch, of the gravity discharge type and hung on a steel roller chain which has an idler end at the rear of the machine so that as the pile of sand decreases in height the digging end of the conveyor may be lowered the required amount by the operator, by taking up some of the idler slack. A heavy cast iron digging drum is mounted on the chain sprocket shaft at the digging end and it is lowered to the sand by means of a friction mechanism.

The buckets empty into a trough above the screens. Gates in this trough distribute the sand evenly to the screens where nails and pieces of iron are removed from the sand, the rejections being discharged on one side and the sand on the other into the hoppers which connect with the molding machine. The machine already built has a vertical lift of 14 feet and a horizontal conveying length of 21 feet.

The machine elevates and screens 120 tons of sand per hour. It is operated by an individual motor, is self-contained and can be modified to handle and screen other materials as well as sand.

SHRINK-HOLES.

To prevent shrink-holes it is advisable to avoid sudden changes in the thickness of a casting. If that portion of the casting that is unusually thick does not have to be machined, a chill at that point will cause the iron to solidify first on account of the chilling effect of the cold iron. If the heavy section must be machined a heavy riser over that point will overcome the tendency to shrink. Heavy spots should therefore be avoided in castings by the designer.

MIXTURE FOR CLEANING BRASS.

One part of Roche alum and 16 parts of water. The article to be cleaned should be warmed and then rubbed with this mixture and finished with fine tripoli.

TRADE PUBLICATIONS.

MELTING FURNACES AND CORE OVENS.—Buffalo Furnace Works, Buffalo. Twelve page catalog devoted to a description of malleable melting furnaces and core ovens. The melting furnace, which is built in sizes ranging from 10 to 30 tons capacity, was described in the July issue of THE FOUNDRY. A new core oven is also illustrated, provided with shelves or reels constructed in half circles instead of quadrants. These permit of the handling of work up to 6 feet in length. The ovens are built in sections 7 feet square.

GRAPHITE PRODUCTS.—Pettinos Bros., Bethlehem, Pa. Forty-five page catalog devoted to a description of the graphite products made by this concern, embracing those made from American, Ceylon, German and Mexican graphites. Considerable space is devoted to plumbago facing, as well as the Standard core wash or blacking and other facings, including pine charcoal, mineral, anthracite, coke, carbon, soapstone, talc, and mold wash facings. Plumbago crucibles are also shown, as well as graphite for lubricating purposes and pipe joint compound. The catalog is handsomely illustrated with views showing the assorting of plumbago in Ceylon, the packing of the material and the company's graphite and foundry facing plant at Bethlehem.

LIFTING MAGNETS.—Electric Controller & Supply Co., Cleveland. Thirty-two page catalog printed on heavy coated paper, handsomely illustrated, with an embossed cover, devoted to a description of the various types of lifting magnets and their uses made by this concern. The magnets as pictorially shown are used for loading charging boxes for open-hearth furnaces, loading scrap, tubing, rails, etc., into cars, unloading pig iron, handling skull crackers for breaking scrap, lifting plates, angles, billets, crop ends, etc. A list of the users of these magnets is also included.

STEAM PUMPS.—A. S. Cameron Steam Pump Works, New York. Standard size catalog, 157 pages, devoted to a description of the various sizes and types of pumps made by this concern. Considerable useful engineering data is also included.

PUMPING MACHINERY.—Knowles Steam Pump Works, New York. General catalog, K-800, 173 pages. Contains a complete description of the steam pumps, condensers and other power plant machinery built by this concern.

FOUNDRY EQUIPMENT.—Manufacturing, Equipment & Engineering Co., Boston. This concern is sending out a number of folders and leaflets describing its stock racks, improved soda and potash kettles, cylindrical metal lockers and all-metal stools.

GENERAL INDUSTRIAL NOTES

The Wm. H. Page Boiler Co., Norwich, Conn., now operating foundries at that point and at Exeter, N. H., has outgrown the capacity of these plants and is preparing to concentrate its business at Meadville, Pa., where a new plant will be ready for operation about Feb. 1. This plant is being constructed in the shape of a "U," with tracks running down the middle and yard space between the tracks and the buildings on either side. Each leg of the "U" will be 500 feet in length and the buildings will be 90 feet in their shorter dimensions. One leg and the connecting structure will accommodate the foundry and machine shop, the office will occupy a corner of the other leg and the storehouse will complete the letter. The plant will be equipped throughout with electricity, generated on the ground and with compressed air. Trolleys will be electrically driven. The melting capacity will be 21 tons an hour. The Page company now operates a plant at Norwich, where it has been in business for more than a half century, and the foundry of the Exeter Machine Works at Exeter. Both plants will be abandoned when the Meadville plant is completed. C. Theodore Campbell is manager of the company's New York office, 713 Park Row building.

The Hardwick Foundry & Machine Co., Dallas, Tex., has recently completed its new foundry and machine shop. The melting equipment consists of a 72-inch cupola and the foundry is commanded by a 10-ton electric traveling crane. S. W. Hardwick is vice president and general manager, and H. F. Wesson, foundry superintendent.

The Dallas Gin & Foundry Co., Dallas, Tex., has leased its plants to the Southern Foundry Co. This concern will engage in the manufacture of cotton gins.

The Kent Mfg. Co., Kent, O., has been succeeded by the Venango Mfg. Co., Franklin, Pa. This concern is engaged in the manufacture of railway supplies.

Articles of incorporation have been filed by the Maysville Foundry & Engineering Co., Maysville, Ky., with a capital of $50,000. Among those interested in the new enterprise are: E. P. Browning, S. P. Browning, and J. W. Fitzgerald.

At a recent meeting of the Trustees of the Commons, New Castle, Del., the agreement with the Tropenas Steel Co. to purchase for that company 100 acres of land at a cost of $7,900, was accepted and the deal closed. The company binds itself to place the plant in operation by Sept. 1, 1909, and to operate continuously for a period of 10 years or forfeit the property to the trustees.

The American Stove & Foundry Co., St. Joseph, Mo., has been incorporated with an authorized capital of $25,000 by Joseph L. Freeland, W. E. Thompson and D. C. Reeves.

The Logansport Radiator & Equipment Co., Logansport, Ind., has been organized with a capital stock of $50,000. J. F. Digan, Geo. L. K. Morrow and John O'Donnell have been elected directors.

The Bartlesville Foundry & Machine Works, Bartlesville, Okla., has placed its new plant in operation.

The Powers-Maxwell Foundry Co., Negley, O., has been chartered by E. W. Powers, S. E. Maxwell, E. I. Moore, F. A. Bricker, and R. P. Grist, with a capital of $10,000.

The Gonder & Birch Co., Elm Grove, W. Va., has been incorporated to operate a foundry and machine shop. The capital stock of the company is $10,000, and the incorporators are: William Birch, William Gonder and George Leinweber.

The General Electric Co. expects to have its new foundry now under construction at Pittsfield, Mass., in operation early next summer. The building is 175 x 400 feet.

The Arcade Malleable Iron Co., Worcester, Mass., has removed from its old works on Washington square and is now operating its remodeled plant at Albany and Muskeego streets, with a force of 100 men. Its capacity for the production of malleable castings has been greatly increased.

The new plant of the Tiffin Malleable Iron & Chain Co., Tiffin, O., is now completed and ready for operation. T. K. Webster Jr. is secretary and treasurer and H. L. Waterbury manager of the new company.

The Charlotte Pipe & Foundry Co., Charlotte, N. C., has completed a new foundry for the manufacture of a full line of soil pipe and fittings in all sizes. The plant is built on a site of 45 acres, and is located within the city limits. The buildings are of fireproof construction, and the facilities and equipment for the manufacture are modern in every detail. The equipment is electrically operated by individual motors. The main buildings cover about two acres, which, together with the machine shops, pattern shops, pattern storage and warehouse, etc., constitute one of the largest soil pipe foundries in the country.

The Michigan Malleable Iron Co., Detroit, has recently increased its capital stock from $600,000 to $800,000 and is planning extensive improvements to its plant.

The Barnes Machine & Tool Co., Victor, Colo., is now occupying its new foundry and machine shop and is prepared to fill orders for jobbing work promptly. E. A. Barnes is president and manager and D. O. Lemoi secretary and treasurer.

New Construction.

The Marshall Car Wheel & Foundry Co., Marshall, Tex., is erecting a new foundry 130 x 265 feet, to replace the one recently damaged by fire. Castings are now being made in a temporary structure. The new plant will be completed about Feb. 1. The producing capacity has been increased about 50 per cent.

Th Standard School Desk Mfg. Co., Columbus, Ga., is erecting a foundry 60 x 150 feet, one-story, in addition to a large furniture factory. The company will manufacture school desks, office fixtures, etc. M. O. Berry is president and J. B. Banks general manager.

Watson Bros. Iron Works, Albany, Ore., recently incorporated, will operate a jobbing foundry in addition to the manufacture of saw mill machinery. A foundry, 40 x 66 feet, and a two-story building, 40 x 66 feet, for machine and pattern shops and pattern storage, will be erected.

The Sturgis Machine Co., Sturgis, Mich., builder of woodworking machinery, is preparing plans for a machine shop, 60 x 90 feet, two stories, with basement for storage, and a foundry 40 x 70 feet. The buildings will be erected on ground purchased last August.

The James A. Brady Foundry Co., Thirty-fifth street and Ashland avenue, Chicago, manufacturer of machinery castings, has leased adjoining land which now gives it a ground space of 120 x 600 feet. It has recently completed and equipped a new shop, 90 x 250 feet, with a 30 x 75-foot pattern and office room addition, at an approximate cost of $50,000.

The Standard Oil Co. is erecting an extensive plant at Bayway, N. J., which will include a foundry, 50 x 100 feet; machine shop, 100 x 200 feet; woodworking building, 150 x 300 feet; forge shop, power house, refinery and other buildings. Extensive additions to the foundry and machine shops of the National Transit Co., Oil City, Pa., a subsidiary company, are also planned, and a large amount of equipment will be required for both plants.

The Oscar Barnett Foundry Co., Newark, N. J., is making plans for the erection of a new plant.

The Coatesville Boiler Works, Coatesville, Pa., will erect a new foundry and machine shop, each 60 x 120 feet, for the manufacture of grate bars and similar castings.

The King Stove & Range Co., Sheffield, Ala., will erect a new foundry, 300 feet long, to replace the part of its plant recently destroyed by fire. The equipment will include a complete overhead trolley system.

Brass Foundries.

The New England Trolley Wheel Co., Chicopee, Mass., has filed articles of incorporation with a capital of $50,000. The officers of the company are: President, Louis J. Tetlow; treasurer and clerk, Michael F. Shea, both of Chicopee Falls.

The new plant of the O. O. Storle Valve Co., Kewaunee, Wis., was placed in operation on Jan. 2. This concern will make a specialty of the manufacture of high pressure valves and hydrants and has just completed a commodious brass and gray iron foundry.

E. M. Boland, A. P. Ryan, N. Boland, A. M. Boland and J. Lamkuhl have chartered the Model Brass Foundry Co., Cincinnati, with a capital of $7,500.

Charles Redlinghouse has purchased the brass foundry of Miles Sweeny at 73 Hamilton street, Newark, N. J., and has made a number of improvements to the plant, including the installation of a new core oven built by E. E. Steiner, of Newark.

The Kokomo Brass Works, Kokomo, Ind., will rebuild at once the portion of its plant recently destroyed by fire. The damage was confined principally to the stock room and pattern room, which were almost completely destroyed, but the insurance is ample.

The Damascus Bronze Co., Allegheny, Pa., manufacturer of brass and bronze castings, has purchased land adjoining its plant and will erect a brick and steel foundry building, 75 x 100 feet. Construction will begin early in the spring.

The Turner Brass Works has moved its general office and factory from Chicago to Sycamore, Ill., where all correspondence will be received in the future.

The Davenport Locomotive Co., Davenport, Ia., made the first heat in its new brass foundry on Jan. 2. The iron foundry was also recently placed in operation.

Index to Volume XXXI

September 1907—February 1908

Advice to Pattern Shop Foremen..... 10
Alloy, Copper, Experiments..... 129
Alloys, Magnalium 108
Alloys, Nickel 208
Aluminum Alloys 285
Aluminum, Carborundum Molds for Casting 208
Aluminum, Light Alloys 29
Aluminum, Production in 1906..... 63
Aluminum, Use of in the Ladle..... 79
American Brass Founders' Association..... 238
American Society of Mechanical Engineers, Report of Annual Meeting..... 241
Annealing Furnace, Pneumatic Charging Machine for 260
Annealing Scale, Use of Borings for..... 291
Antimony, Use of 299
Around the Foundry Circuit..... 136

Balkwill Pattern Co., Description of Shop. 260
Band Saw Filing Machine, The Foley.... 92
Bassite Substitute for Tin..... 46
Beam, Equalizer 145
Bearings, Railroad 289
Bearings, Trolley Car Wheel..... 134
Bed Plate, Method of Molding..... 219
Bell Castings, Mixture..... 67
Bell Castings, Steel Added to the Mixture 135
Bellows, Cyclone 45
Bench, Hudson's Snap..... 92
Birmingham Branch of the British Foundrymen's Association 141-244
Blast Pipes, Cupola, Table of Diameters, Data Sheet No. 5, November, 1907.
Blocks, High Speed Triplex, for Brass Foundries 45
Blow Holes and Gases in Cast Iron..... 284
Blower Practice 180
Blowers, Method of Testing, Data Sheet No. 5, November, 1907.
Blowers, Motor Driven 255
Blowing Around Chills..... 136
Bonnard, Henry, Bronze Co., Description of Plant 201
Bonus Distribution, Wyckoff, Seamans & Benedict 288
Borings, Melting Cast Iron in the Cupola.. 301
Borings, Use of for Annealing Scale..... 291
Braddock Foundry & Machine Co.'s Cost System 116
Brass, Acid Resisting 79
Brass Alloys, for Railroad Bearings..... 289
Brass Alloys, McAdamite 81
Brass and Bronze Bars, Results of Series of Tests 21
Brass Bearing Castings for Automobiles.. 69
Brass Castings for Automobiles..... 130
Brass, Cold Pouring of..... 78
Brass Cylinders and Bearings..... 272
Brass Digester for Sulphite Pulp..... 79
Brass Dip 23
Brass Driving Boxes 134
Brass, Dross Difficulties 293
Brass Drum 133
Brass Fittings 210-293
Brass Foundry Difficulties 23
Brass Foundry Notes 292
Brass Foundry, The Jobbing 127-285
Brass Foundry, The Jobbing, Design and Construction 178
Brass Foundry, The Jobbing, Mixtures... 209
Brass Foundry, Ventilating the..... 72
Brass Furnaces, Oil Burner for..... 77
Brass Hydraulic Valves..... 210
Brass Machinery 231
Brass Melting on a Forge..... 292
Brass, Modern Methods of Melting..... 179
Brass Road Roller Bearings..... 78
Brass Trolley Car Wheel Bearings..... 134
Brass Car Wheels 173
Brass, Yellow 23-264
Brass, Yellow, Methods of Casting..... 76
Brass, Yellow, Use of 199
Brasses, Car 78
British Foundrymen's Association, Annual Meeting 30
British Foundrymen's Association, Birmingham Branch 141-244
British Foundrymen's Association, Sheffield Branch 231
British Foundry Practice 95
Bronze Foundry, Ornamental..... 201
Bronze Nozzles 133
"Burning On" Iron Inside of a Steel Ring 215

Calculating Mixtures 51
Canadian Tariff Regulations for A. F. A. Exhibitors 49
Carbon, Influence of, on Cast Iron..... 114
Carborundum Molds for Casting Aluminum 208
Carburetor Body, Method of Molding..... 130
Cast Iron, Blow Holes and Gases in..... 284
Cast Iron Borings 237
Cast Iron, Flux for Brazing 195
Cast Iron Notes 239
Cast Iron Pipe, Continuous Method of Manufacture 149
Cast Iron, Solidification of 107
Cast Steel Gear Blanks 240
Casting, A Liner Without a Pattern..... 207
Casting, A Troublesome Driving Brass... 206
Casting, Molding a Large Cylinder..... 265
Casting Retort, Molding a..... 109
Castings, A New Foundry Journal..... 143
Castings, Bearing, for Automobiles..... 69
Castings, Bell 67
Castings, Brass, for Automobiles..... 130
Castings, Cracked Stove 79
Castings, Cylinder 87
Castings, Gray Iron, Standard Specifications for, Data Sheets 9 and 10, January, 1908.
Castings, Malleable, Scale Burnt 56
Castings, Manufacture of Large..... 222
Castings, Melting Iron for..... 51
Castings, Semi-Steel 96
Castings, Thin 143
Castings, Uniform Contract for 138
Castings, Valve 80
Castings, Weight of, Method of Ascertaining from Weight of Patterns, Data Sheet No. 7, December, 1907.
Cement, Iron, Smooth-on..... 14
Charcoal Iron for the Foundry..... 230
Charging Machine, Cupola..... 146
Chicago Associated Foundry Foremen.... 218
Chill, To Cast Iron Against..... 188
Chills for Sash Weights..... 124
Chords of Angles from 1 to 90 Degrees, Data Sheet No. 4, October, 1907.
Cincinnati Associated Foundry Foremen.. 298
Clamps, Thompson Adjustable 90
Cleveland Club of Associated Foundry Foremen 20-301
Closing Device for Cupola Bottom Doors. 126
Cold Saw Cutting Off Machine, Steel Foundry 147
Continuous Foundry Systems..... 86
Contract, Uniform, for Castings..... 138
Convention of American Foundrymen's Association 195
Convertor vs. Small Open Hearth 137
Convertor vs. Small Open Hearth, (II).... 169
Convertor vs. Small Open Hearth, (III)... 243
Copper Castings, Electrical Conductivity of 134
Copper Castings, Production in 1907..... 134
Core Oven, For Small Cores..... 198
Core Oven, Modern 304
Core Oven, Recording Thermometers 196
Core Ovens, Black Diamond..... 91
Core Sand, A Mountain of..... 144
Core Wire, Peculiar Expansion of..... 79
Cores, Steel, Wash for..... 80
Correspondence Course in Foundry Practice 75
Cost Finding 269
Cost System for Jobbing Foundry.....116-233
Cothias Metal, Use of for Castings..... 287
Crane, Charging Floor..... 196
Cupola Blast Pipes, Table of Diameters, Data Sheet No. 5, December, 1907.
Cupola Bottom Door Closing Device..... 126
Cupola Charging Machine 146
Cupola, Equipped with Receiver..... 28
Cupola, Melting Different Grades of Iron for Castings from One..... 79
Cupola Practice and Iron Mixtures..... 157
Cupola Practice, Melting Iron for Castings 51
Cupola Records, Daily 303
Cupolas, Arrangement of 135
Cylinder, Air Cooled Gas Engine, Method of Molding 2

Dauber, Ladle 303
Design and Construction of Foundry Buildings 16
Design of the Iron Foundry..... 227
Drawing Board, Pattern Shop 288
Driving Boxes, Brass..... 134

Education of Brass Foundry Apprentices.. 38
Equalizer, Cast Steel Triangular..... 19
Exhibit, Chicago Associated Foundry Foremen's 272
Experiences of Mr. Knowit, the Expert Melter 68
Exposition of Foundry Equipment..... 218
Electrical Conductivity of Copper Castings 134

Ferro-Alloys for Foundry Use..... 39
Ferro-Silicon, Experiments with..... 87
Fittings, Brass 210
Flask Storage 142
Flasks, Barred 267
Fluor Spar, Production of in 1906..... 115
Flux for Brazing Cast Iron..... 195
Flux for Iron Castings..... 123
Fly Wheel Completed in Record Time.... 115
Foundry for Bench Work..... 174
Foundry for Stove Plate 174
Foundry Iron, Model Pacific Coast..... 57
Foundry, Pig Iron Specifications for, Data Sheet No. 1, September, 1907.
Foundry, Steel, Equipped with Tilting Open-Hearth Furnace 6
Fox, Martin 120

Gas Engine, Fly Wheel, Pattern..... 15
Gates and Risers or Sink-Heads..... 112
Gear Blocks, Cast Steel..... 240
General Industrial Notes..50-98-148-199-256-307
Glue, Waterproof 87
Goulds Mfg. Co.'s Foundry..... 294
Grate, Malleable Furnace 305
Gray Iron Foundry, A Model..... 294
Grinder, Revolving Oil Stone Edge Tool.. 302
Grinding Wheels, Speed Controller for.... 144

Hendricks Commercial Register 75
Hill Clutch Co.'s Iron Foundry..... 24
How Are Cast Iron Borings Melted in a Cupola? 237
Hydraulic Valves 210

Keystone Steel Casting Co., Chester, Pa., Description of Plant..... 245

Imaginary Difficulties 173
Industrial Notes, General..50-98-148-199-256-307
Iron, Charcoal for the Foundry..... 230
Iron, Clean 123
Iron, Conveyance in the Foundry..... 299
Iron, Dull 239
Iron, Three Mixtures from One Cupola.. 239

Ladle Dauber 303
Liquid Chalk 143

McAdamite, New Alloy 81
McHaffie Process 245
Machine Cores for Foundry Use..... 248
Machine Molded Drop Hangers..... 267
Machine, Molding Large Machine Frame.. 82
Machine, Portable Metal Grinding and Buffing 255
Machinery Castings, Mixtures for..... 171
Magnets, Lifting, for Foundry Use..... 98
Malleable Annealing Furnace Charging Machine 260
Malleable Castings, Mixture for..... 171
Malleable Castings, Over-Annealed 188
Malleable Castings, Production of, I..... 257
Malleable Castings, Standard Specifications for, Data Sheet No. 8, December, 1907.
Malleable Fittings, Production of..... 99
Malleable Furnace Grate 305
Malleable Melting Capacity, Increase to.... 265
Malleable Iron, Freezing of..... 240
Malleable Iron Industry, Growth of..... 262
Malleable Iron, Sandless Molds for..... 80
Malleable Iron, Production of in 1907..... 262
Malleable Scrap 299
Malleable Scrap, Use of, for Gray Iron Castings 239
Malleable Works, Built Since July, 1906.. 262
Malleable Works, In the United States.. 262
Manganese Bronze for Propeller Wheels.. 133
Metal, White, for Patterns..... 238
Metallurgical Plant, New 304
Michigan Stove Co., Gray Iron Foundry.. 174
Mill, Sand Grinding 254
Milwaukee Foundry Foremen 14
Mixer, Heated, for Foundry Use.....84-221
Mixtures, For Machinery Castings..... 171
Mixtures, For Malleable Castings..... 171
Mixtures, For Valves 187
Mixtures, Hard Iron, for Heavy Work.... 160
Mixtures, Jobbing Brass Foundry..... 209
Mixtures, Medium Iron, for General Work 160
Mixtures, Method of Calculating..... 161
Mixtures, Method of Calculating for the Cupola, Data Sheet No. 3, October, 1907.
Mixtures, Sand 191
Mixtures, Sand, for Machine Made Cores. 249
Mixtures, Semi-Steel 187
Mixtures, Soft Iron 160
Mixtures, White Metal 188
Modern Core Oven 304
Molders' Bulb Sponge..... 44
Molding a Cast Steel Runner..... 60
Molding a Large Cylinder Casting..... 265
Molding a Web Pulley..... 276
Molding Machine, B-4, Ph. Bonvillain & E. Ronceray 251
Molding Machine Combination Stripping Plate and Vibrator 267
Molding Machine, Limitations of..... 273
Molding Sand, Mechanically Treated..... 189
Molding Sand, Production of, in 1906..... 106
Molds, Gas Producer for Skin Drying.... 196
Morse Iron Works, Erie, Pa..... 99

New England Foundrymen's Association.95-141
New Steel Casting Plant..... 138
Nickel Alloys 208
Nickel Melting in a Brass Furnace..... 292
Nickel, Method of Casting..... 293
Nozzles, Bronze 133

Obituary 49-87-143-195-301
Olympic Foundry Co., Description of..... 57
Oven Core, for Small Cores..... 198

Pattern, Cast Steel Triangular Equalizer.. 19
Pattern for Gas Engine Fly Wheel..... 15
Pattern Lumber, Specific Gravity and Average Weight per Cubic Foot, Data Sheet No. 7, December, 1907.
Pattern Shop, Drawing Board..... 288
Pattern Shop, Location of..... 121
Pattern Shop, Organization of 281
Pattern Shop Sanding Schemes 278
Patterns for Repetition Work 163-211
Patterns, Metal Mounting of..... 104
Patterns, Method of Gaging Thickness.... 156
Patterns to Suit the Foundryman..... 11
Personal 49-87-143-195-301
Philadelphia Foundrymen's Association...94-141
Philadelphia Foundry Foremen.....195-229-299
Pig Iron Production 48
Pilkington, Herbert, Career of..... 34
Pittsburg Foundrymen's Association.....94-140
Planing Draft 13
Platinum, Substitute for..... 42
Prescott Foundry Co..... 6
Production of Copper, Spelter and Lead in 1906 49
Production of Malleable Castings, I..... 257
Propeller Wheels, Manganese Bronze for.. 133
Pulley Arms, Cracking of..... 135
Pulley Molding, Hill Clutch Co., Foundry. 24
Pulley Web, Method of Molding..... 276

Receiver for Molten Iron..... 28
Regulation of Foundry Conditions..... 194
Rumbling Castings 162
Runner, Cast Steel, Molding a..... 60

Sal-Ammoniac, Substitute for in Annealing Scale 240
Sand Blast Nozzles, Lunkenheimer..... 93
Sand Elevating and Screening Machine.. 306
Sand Grinding Mill 254
Sand Mixtures for Machine Made Cores.. 249
Sash Weights Cast in Chills..... 124
Scarred Surfaces of Iron Tablets..... 239
Selling the Foundry Product..... 97
Semi-Steel 188
Semi-Steel Castings 96
Semi-Steel Mixtures 187
Silicon, High 80
Skin Drying Molds with a Gas Producer.. 196
Slag, Acid Open Hearth..... 5
Slag, Foaming in the Cupola.....29-136
Slip Boxes, Galvanized Iron..... 147
Solder for Aluminum..... 170
Soldering, New Compound..... 42
Specifications for Iron and Fuel..... 171
Standard Specifications for Foundry Pig Iron, Data Sheet No. 1, September, 1907.
Standard Specifications for Gray Iron Castings, Data Sheets Nos. 9 and 10, January, 1908.
Standard Specifications for Malleable Castings, Data Sheet No. 8, December, 1907.
Standard Specifications for Steel Castings, Data Sheets Nos. 11 and 12, February, 1908.
Steel Casting by the McHaffie Process.... 245
Steel Castings, Standard Specifications for, Data Sheets Nos. 11 and 12, February, 1908.
Steel Foundry, Cold Saw Cutting-off Machine 147

Table for the Rapid Conversion of Gross Tons and Fractions Thereof Into Pounds, Data Sheet No. 2, September, 1907.
Test Bars, Analysis of English..... 79
Thermometers, Bristol, Recording for Core Ovens 196
Titanium in Steel & Iron..... 192
Trade Notes 46-90-146-197-253-305
Trade Outlook 48-86-142-194-250-300
Trade Publications 47-71-93-139-198-238-306
Tramrails, Overhead for the Foundry..... 64
Trolley Wheels 173
Turning Tool Box for Patternmakers..... 81
Tuyeres, Knoeppel Continuous System..... 43

Uniform Foundry Cost System..... 250
United States Cast Iron Pipe & Foundry Co., Scottdale, Pa., Description of Plant 149

Vanadium and Auto Cylinders..... 162
Ventilation of Foundries..... 90

Wax Fillet Machine..... 214
Western Foundry Supply Co..... 89
White Metal Mixtures..... 188

Authors' Index to Volume XXXI

September 1907—February 1908

A. B. C. Wax Fillet Machine 214

Bell, Daniel. Bottom Door Closing Device 126
Berry, E. H. Patterns for Repetition Work 163-211
Binns, W. How are Cast Iron Borings Melted in the Cupola? 237
Bole, W. A. Manufacture of Large Castings 222
Brown, J. L. "Burning On" Iron Inside of a Steel Ring..... 215
Buchanan, J. F. Use of Antimony..... 299
Buchanan, J. F. The Jobbing Brass Foundry 127
Buchanan, J. F. The Jobbing Brass Foundry, Design and Construction..... 176
Buchanan, J. F. The Jobbing Brass Foundry, Mixtures 209
Buchanan, J. F. The Jobbing Brass Foundry, Aluminum Alloys 285

Carr, W. M. Acid Open-Hearth Slag..... 5
Carr, W. M. Cast Steel Gear Blanks.... 240
Carr, W. M. Converter vs. the Small Open Hearth (I)..... 137
Carr, W. M. Converter vs. the Small Open Hearth (II)..... 169
Carr, W. M. Converter vs. the Small Open Hearth (III)..... 243
Carr, W. M. Wash for Steel Cores..... 80
Clamer, G. H. Alloys for Railroad Bearings 289
Cleveland, R. B. A Pattern Shop Foreman's Advice 10

DePont, Harry B. Charcoal Iron for the Foundry 230
DePont, Harry B. Tests of Some Brass and Bronze Bars..... 21
Dwyer, Emmett, & W. J. Keep. A Foundry for Bench Work..... 174

Estep, H. Cole. A Model Pacific Coast Iron Foundry 57

Falconer, Kenneth. Cost Finding..... 269

Hatfield, W. H. Influence of Carbon on Cast Iron 114
Hooper, George K. Design and Construction of Foundry Buildings..... 16
Horne, Emil B. Use of Cothias Metal for Castings 287
Horton, J. Annual Meeting of the British Foundrymen's Association..... 30
Houghton, E. Ferro Alloys for Foundry Use 39

Johnson, J. F. Jobbing Foundry Cost System 110
Jones, Dayton. Turning Tool Box for Patternmakers 81
Jones, J. E. Stacey. Light Aluminum Alloys 29

Kebler, Elliott A. Selling the Foundry Product 97
Keep, W. J. Cast Iron Notes. 28-79-135-187-239
Keep, W. J. Foundry Cupola and Iron Mixtures 157
Keep, W. J., and Emmet Dwyer. A Foundry for Bench Work 174

Lake, E. F. Air Cooled Gas Engine Cylinder 2
Lake, E. F. Bearing Castings for Automobiles 69
Lake, E. F. Brass Castings for Automobiles 131
Luhrsen, Louis. Casting, A Troublesome Driving Brass 207
Luhrsen, Louis. Oil Burner for Brass Furnace 77

McCarter, W. W. Method of Molding a Large Bed Plate..... 219
McCarter, W. W. Method of Molding a Web Pulley 276
McCaslin, H. J. A Cast Steel Triangular Equalizer 19
McCaslin, H. J. Molding a Cast Steel Runner 60
McGahey, C. R. Molding a Large Cylinder Casting 265
McIntosh, W. J. British Foundry Practice 95
McLain, David. Semi-Steel Castings..... 96
Madison. Method of Gaging the Thickness of Patterns 156
Mason, C. W. Uniformity and Modern Ideas for Making Pig Iron..... 140
Mayer, W. Casting a Liner Without a Pattern 207
Moldenke, Richard. Freezing of Malleable Iron 240
Moldenke, Richard. Over-Annealed Malleable Castings 188
Moldenke, Richard. Production of Malleable Castings 257
Moldenke, Richard. Sandless Molds for Malleable Cast Iron..... 80
Moldenke, Richard. Scale Burnt on Malleable Castings 56
Moldenke, Richard. Specifications for Iron and Fuel 171
Moldenke, Richard. Substitute for Sal-Ammoniac in Annealing Scale..... 240
Moldenke, Richard. Use of Borings for Annealing Scale 291
Moldenke, Richard. Use of Malleable Scrap for Gray Iron Castings..... 239
Moyer, A. W. Overhead Tramrails for the Foundry 64
Mumford, E. H. Limitations of the Molding Machine 273

Nau, J. B. Use of a Heated Foundry Mixer 84
Nall, Jabez. Molding a Retort Casting... 109

O'Donnell, T. E. Pattern for Gas Engine Fly Wheel 15
Outerbridge, Alexander E., Jr. Clean Iron 173
Outerbridge, Alexander E., Jr. Experiments with Ferro-Silicon..... 87
Outerbridge, Alexander E., Jr. Mechanically Treated Molding Sand..... 189

Perrigo, Oscar E. Design of the Iron Foundry 227
Perrigo, Oscar E. Location of the Pattern Shop 121
Perrigo, Oscar E. Patterns to Suit the Foundryman 11

Quigley, W. S. Modern Methods of Melting Metal 179

Ramp, Paul R. Gates and Risers, or Sink Heads 112
Ramp, Paul R. Rumbling Castings 162
Rhead, E. L. Solidification of Cast Iron. 107

Sayers, H. Imaginary Difficulties 173
Shaw, T. Melting Cast Iron Borings in the Cupola 301
Slocum, C. V. Titanium in Steel and Iron 192
Smith, Eugene W. The Various Methods of Iron Conveyance in the Foundry.. 299
Snow, Walter B. Foundry Blower Practice 180
Snow, Walter B. Ventilating the Brass Foundry 72
Sterling, James L. Cost System for the Jobbing Foundry 233
Stoughton, Bradley. Melting Iron for Castings 51

Tuttle, H. N. A Few Sanding Schemes.. 278
Tuttle, H. N. Planing Draft 13

Vickers, C. Brass Fittings 210
Vickers, C. Brass Foundry Difficulties Solved 133
Vickers, C. Brass Foundry Notes....23-78-292
Vickers, C. Copper Alloy Experiments.... 129
Vickers, C. Hydraulic Valves 210
Vickers, C. Machinery Brass 231
Vickers, C. Method of Casting Yellow Brass 76
Vickers, C. Nickel Alloy 208
Vickers, C. Use of Yellow Brass..... 188

Wadsworth, George H. Machine Cores for Foundry Use 248
Waterhouse, G. B. Blow Holes and Gases in Cast Iron 284
Wright, Setu. Around the Foundry Circuit 136

Data Sheets

September 1907—February 1908

No. 1, September, 1907.—Standard Specifications for Foundry Pig Iron.

No. 2, September, 1907.—Table Arranged for the Rapid Conversion of Gross Tons and Fractions Thereof Into Pounds.

No. 3, October, 1907.—Method of Calculating Mixtures for the Cupola.

No. 4, October, 1907.—Chords of Angles from 1 to 90 degrees.

No. 5, November, 1907.—Table of Diameters of Cupola Blast Pipes for Lengths 20 to 140 feet, and Losses of ¼ and ½ Ounce Pressure per Square Inch.

No. 6, November, 1907.—Testing Blowers.

No. 7, December, 1907.—Method of Ascertaining the Weight of Castings from the Weight of Patterns, and Specific Gravity and Average Weight per Cubic Foot of Pattern Lumber.

No. 8, December, 1907.—Standard Specifications for Malleable Castings.

Nos. 9 and 10, January, 1908.—Standard Specifications for Gray Iron Castings.

Nos. 11 and 12, February, 1908.—Standard Specifications for Steel Castings.

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ADVERTISERS

Adams Co. 18, 137
Addy, Matthew, & Co. 151
Ajax Metal Co. 143
Albany & North River Molding Sand Co. . 138
American Air Compressor Works. 140
American Blower Co. 47
American Wire Brush Co. 110
Arcade Mfg. Co. 21
Atlas Car & Mfg. Co. 127

Baird & West 151
Barnett, Oscar, Foundry Co. 24
Bassite Mining & Smelting Co. 31
Berkshire Mfg. Co. 20
Blackwell, Geo. G., Sons & Co. 143
*Blake, Geo. F., Mfg. Co. ..... —
Borgner, Cyrus, Co. 147
Box & Co., Alfred 122
Brass Founders' Supply Co. 136
Bridgeport Safety Emery Wheel Co. 140
Bristol Co. 142
Brown Hoisting Machinery Co. 121
Brown Specialty Machinery Co. 26
Burdick & Son 131
*Byram & Co. ..... —

Carborundum Co. 117
Carr & Speer 119
Case Mfg. Co. 124
Central Foundry Supply Co. 131
Clark Cast Steel Cement Co. 28
Cleveland Crane & Car Co. 122
Cleveland Fillet Co. 140
Columbus Iron & Steel Co. 150
Connersville Blower Co. ..... Back cover
Cornell, J. B. & J. M., Co. 147
Crivel & Co., George F. 132
Curtis & Co. Mfg. Co. 128

*Deane Steam Pump Co. 139
Debevoise-Anderson Co. 151
DeCamp Bros. & Yule Iron, Coal & Coke Co. 151
Detroit Foundry Supply Co. 113
Diamond Clamp & Flask Co. 136
Dimmick, J. K., & Co. 151
Dings Electro Magnetic Separator Co. 146
Dixon, Jos., Crucible Co. 51
Dobson, William 137
Dodge & Day 144
Doggett, Stanley ..... —
Domhoff & Joyce Co. 150
Drucklieb, C. 117

Electric Controller & Supply Co. 125
Elm City Engineering Co. 146
Engineers' & Founders' Laboratories. 144
Etting, Edward J. 129

Falls Rivet & Machine Co. 10
Field, Alfred, & Co. 145
Field, Robt., Sales Agency. 150
Foundry Specialty Co. 134
Fox Machine Co. 135

Gautier, J. H., & Co. 54, 140
General Audit Co. of Ohio. 1
General Pneumatic Tool Co. 123
Gilmour, J. 130
Goldschmidt Thermit Co. 135
Goodrich, F. A., & Co. 151

Harbison-Walker Refractories Co. 147
Harrington, Edward, Sons & Co. 125
Hawley Down Draft Furnace Co. 42
Herman Pneumatic Machine Co. 22
Hill & Griffith Co. 8
Hillman, J. H., & Son 150
Hoist Co., The 123
Hudson, J. M. 135

Jones & Attwood 145

Keep, W. J. 144
Kerr Turbine Co. 132
Kessler & Weidemann 144
Killing Molding Machine Co. 19
Knickerbocker Company 115

Laclede-Christy Clay Products Co. 147
Lindsay, W. W., & Co. 45
Link-Belt Co. 124

Manning, Maxwell & Moore 120
Maris Bros. 122
Maurer, Henry, & Son 147
McCormick, J. S., Co. 34
McCullough-Dalzell Crucible Co. 50
McKeefrey & Co. 150
Metallic Alloys Co. 142
Metallurgical Laboratory 142
Middleditch, Benj. 137
Midvale Mining & Mfg. Co. 141
Millet Core Oven Co. 25
Mitchell-Parks Mfg. Co. 23
Mohr, J. J., & Son 150
Monarch Emery & Corundum Wheel Co. 115
Monarch Engineering & Mfg. Co. 43
Morton Manufacturing Co. 133
Moyer Tramrail Co. 126
Mumford, E. H., & Co. 16, 17, 20

Nash, Isham & Co. 151
New England Eng. & Equipment Co. 124
New Era Mfg. Co. 142
Newport Sand Bank Co. 138
Niles-Bement-Pond Co. 121
Northern Engineering Works. 120, 129
Norton Co. 115
Norwalk Iron Works Co. 130

Obermayer, S., Co. 2, 3
Osborn Mfg. Co. 153
Otis Steel Co. 140

Paige Retort & Crucible Co. 131
Pangborn Company, Thomas W. 9
Partamol Co. 116
Pattern Letter Co. 140
Pawling & Harnischfeger 123
Paxson, J. W., Co. 4, 5, 6
Peninsular Tool & Specialty Co. 135
Penn, Wm., Silica Works. 147
*Pettinos Bros. ..... —
Philadelphia Tramrail Co. 127
Phosphor Bronze Smelting Co. 142
Pickands, Brown & Co. 151
Pickands, Mather & Co. 150
Pilling & Crane 150
Piqua Blower Co. 55
Pridmore, Henry E. 12, 13

Rathbone, John A. 16
Rendle, Arthur E. 138
Ridgway, Craig, & Son Co. 46
Roberts Portable Oven Co. 145
Robeson Process Co. 27
Rockwell Engineering Co. 27
Roessler & Hasslacher Chemical Co. 141, 143
Rogers, Brown & Co. 151, 152
Roots, P. H. & F. M., Co. ..... Insert
Ross-Tacony Crucible Co. 53

Samuel, Frank 150
Seaver, John W. 144
Seidel, R. B., Inc. 129
Sellers, Wm., & Co. 39
Shanafelt Mfg. Co. 32
Shelton Metallic Filler Co. 30
Shepard, Chas. G. 151
Shuster, F. B., Co. 146
Sly, W. W., Mfg. Co. 38
Smith, J. D., Foundry Supply Co. 11
Smooth-On Mfg. Co. 29
Swoboda, L. J. 134
Standard Sand & Machine Co. 138
Sterling Oil Co. 145
Stevens, F. B. 35, 111, 151
Stockham Mfg. Co. 136
Stow Mfg. Co. 117
Stradley & Co., Edward M. 119
Sturtevant, B. F., Co. 48
Superior Charcoal Iron Co. 140

Tabor Mfg. Co. 14, 15
Taylor, A. L. 140
Taylor, Robt. Jr., Inc. 52
Thomas Furnace Co. 151
Tilghman-Brooksbank Sand Blast Co. 37
Toledo Mfg. Co. 33
Turner Machine Co. 139

U. S. Chaplet Supply Co. 139
United Iron & Steel Co. 149
United States Graphite Co. 132

Waldie & McCauley Sand Co. 138
Walter-Wallingford & Co. 150
Western Foundry Supply Co. 141
Whitehead Bros. Co. 7
Whiting Foundry Equipment Co. 56, 109
Wilbraham-Green Blower Co. 49

Yale & Towne Mfg. Co. 125

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See page 35

BUYERS DIRECTORY

Advertisements can be found readily by reference to the Alphabetical Index

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Norton Company, Worcester, Mass.

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Barnett, Oscar, Fdy. Co., Newark.
Brass Founders' Supply Co., Newark.
Killing Molding Machine Co., Davenport, Ia.

Flasks (Snap):

Adams Co., Dubuque, Ia.
Diamond Clamp & Flask Co., Richmond, Ind.
Killing Molding Machine Co., Davenport, Ia.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.

Foundry Equipment (Iron & Brass):

Barnett, Oscar, Foundry Co., Newark.
Etting, Edward J., Philadelphia.
Morton Mfg. Co., Muskegon Heights, Mich.
New England Eng. & Equip. Co., Boston, Mass.
Northern Engrng. Works, Detroit.
Obermayer, S. Co., Cincinnati.
Pangborn Company, Thomas W. New York.
Sly, W. W. Mfg. Co., Cleveland.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Foundry Supplies:

Central Foundry Supply, Columbus, O.
Crivel & Co., Geo. F., Buffalo.
Detroit Foundry Supply Co., Detroit.
Hill & Griffith Co., Cincinnati.
McCormick, J. S. Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn Company, Thomas W. New York.
Paxson, J. W. Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, A. L., San Francisco.
Taylor, Robert J., Inc., Philadelphia.
Whitehead Bros. Co., New York, Providence, Buffalo.

Furnaces (Melting):

Barnett, Oscar, Foundry Co., Newark, N. J.
Hawley Down Draft Furnace Co., Chicago.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson, J. W. Co., Philadelphia.
Rockwell Engineering Co., New York.

Graphite:

U. S. Graphite Co., The, Saginaw.
Dixon Crucible Co., Jos., Jersey City.

Grinding Machinery:

Adams Co., Dubuque, Ia.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinding Wheels:

Norton Co., Worcester, Mass.

Heating & Ventilating Apparatus:

American Blower Co., Detroit.
Sturtevant, B. F., Co., HydePark, Mass.

Hoists:

Box & Co., Alfred, Philadelphia.
General Pneumatic Tool Co., Montour Falls, N. Y.
Harrington, Edwin, Son & Co., Philadelphia.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee.
Sellers, William, & Co., Inc., Philadelphia.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Electric):

Northern Engrng. Works, Detroit.
Yale & Towne Mfg. Co., New York.

Hoists (Hand):

Northern Engrng. Works, Detroit.

Hoists (Pneumatic):

Curtis & Co. Mfg. Co., St. Louis.
Ridgway, Craig, & Son, Coatesville, Pa.

Industrial Ry. Equipment.

Atlas Car & Mfg. Co., Cleveland.

Iron Ore:

Rogers, Brown & Co., Cincinnati.

Magnets (Lifting):

Electric Controller & Supply Co., Cleveland.

Molding Machines:

Adams Co., Dubuque, Ia.
Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Herman Pneumatic Machine Co., Zelienople, Pa.
Killing Molding Machine Co., Davenport, Ia.
Manning, Maxwell & Moore, New York.
Mitchell-Parks Mfg. Co., St. Louis.
Mumford, E. H. Co., Philadelphia.
Paxson, J. W. Co., Philadelphia.
Pridmore, Henry E., Chicago.
Rathbone, John A., Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.
Tabor Mfg. Co., Philadelphia.

Packing (Rubber Sheet):

Smooth-On Mfg. Co., Jersey City.

Parting Compounds:

Doggett, Stanley, New York.
Foundry Specialty Co., Cincinnati.
Partamol Co., New York.
Swobda, L. J., New York.

Pattern Letters.

Pattern Letter Co., Taunton, Mass.

Pattern Makers' Supplies:

Cleveland Fillet Co., Cleveland.

Patterns (Metal and Wood):

Herman Pneumatic Machine Co., Zelienople, Pa.

Pattern Shop Equipment:

Fox Machine Co., Grand Rapids, Mich.

Phosphorizers:

McCullough-Dalzell Crucible Co., Pittsburg.
New Era Mfg. Co., Kalamazoo.

Pig Iron:

Addy, Mathew, & Co., Cincinnati.
Columbus Iron & Steel Co., Columbus.
DeCamp Bros. & Yule, St. Louis.
Domhoff & Joyce Co., Cincinnati.
Field, Robt., Sales Agency, Cincinnati.
Goodrich, F. A., & Co., Detroit.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., Philadelphia.
Nash, Isham & Co., New York.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.
Superior Charcoal Iron Co., Grand Rapids, Mich.
Thomas Furnace Co., Milwaukee.

United Iron & Steel Co., Pittsburg.
Walter-Wallingford & Co., Cincinnati and Pittsburg.

Plumbago:

Dixon Crucible Co., Jos., Jersey City.
Gautier, J. H., & Co., Jersey City.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
McCullough-Dalzell Crucible Co., Pittsburg.

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Booklet 229 F.

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Chicago Store, 48 So. Canal St.

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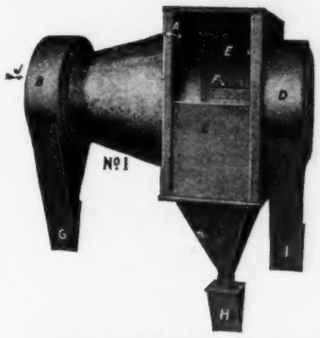

KNICKERBOCKER RAREFIED DUST COLLECTOR

"NOTHING REACHES THE FAN TO CUT IT OUT"—WILL LAST INDEFINITELY ON EMERY WHEELS —RATTLER—SAND BLAST.

Marshall, Mich., December 13, 1907.

The Knickerbocker Co,. Jackson, Mich.
Gentlemen:—

We have been using one of your No. 16 Rarefied Dust Collectors for several months in our cleaning department. We run several emery wheels and a rattler and clean all our castings with a sand blast. We have this Collector connected with a 40 inch Exhaust Fan and the system is working very satisfactorily indeed. The Separator seems to take out every thing that has any specific gravity at all. What little dust does go through the blower is in the form of vapor or smoke and we confidently believe our blower will last indefinitely as nothing reaches the fan to cut it out.

Should we increase our capacity, we shall certainly use another one of your Rarefied Dust Collectors. We are,

Very truly yours,
THE NEW PROCESS STEEL CO.
S. C. French, Gen. Manager.

Manufactured Exclusively by
THE KNICKERBOCKER COMPANY
Jackson, Michigan

Monarch Emery and Corundum Wheels

If you use a Sellers No. 1 or No. 2 Tool Grinder, we have special vitrified wheels that you'll want to know about.

Instead of building them on cast-iron centers, we use a removable center and make our wheels to fit it.

This makes it unnecessary to return the centers when new wheels are needed, insures perfect adjustment, prevents the wheels from coming loose, and results in greater efficiency and economy.

Write for catalogue C.

Monarch Emery & Corundum Wheel Company, Camden, N. J.

Obermayer, S. Co., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
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Stevens, F. B., Detroit.
Whitehead Bros. Co., New York, Providence, Buffalo.

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Riddles:

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Whitehead Bros. Co., New York, Providence, Buffalo.

Sand Blast Machinery:

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Paxson, J. W. Co., Philadelphia.
Tilghman-Brooksbank Sand Blast Co., Philadelphia.

Sand Mixing Machinery:

Falls Rivet & Machine Co., Cuyahoga Falls, O.
Mumford, E. H., Philadelphia.
Pangborn Company, Thomas W. New York.
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Herman Pneumatic Machine Co., Zelienople, Pa.
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Tabor Mfg. Co., Philadelphia.

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Whitehead Brothers Co., New York, Providence, Buffalo.

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Stow Mfg. Co., Binghamton, N. Y.

Shapers:

Morton Mfg. Co., Muskegon Heights, Mich.

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Stevens, F. B., Detroit.

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Shuster, F. B., Co., New Haven.
Middleditch, Benj., Detroit.
Turner Machine Co., Philadelphia.

Stoppers:

McCullough-Dalzell Crucible Co., Pittsburg.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robert J., Inc., Philadelphia.

Testing Machines:

Keep, W. J., Detroit.

Thermit Process:

Goldschmidt Thermit Co., New York.

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Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.
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Tramrail Systems:

Moyer Tramrail Co., Philadelphia.
Philadelphia Tramrail Co., Philadelphia.

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Pawling & Harnischfeger, Milwaukee.
Philadelphia Tram-Rail Co. Philadelphia, Pa.

Tumbling Mills:

Adams Co., Dubuque, Ia.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Gilmour, J., New York.
Sly, W. W., Mfg. Co., Cleveland.

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Field, Alfred & Co., New York City.

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"Success" means willingness to put aside the old for something better.

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Is a practical machine that fits in with the existing conditions in any foundry without special installation.

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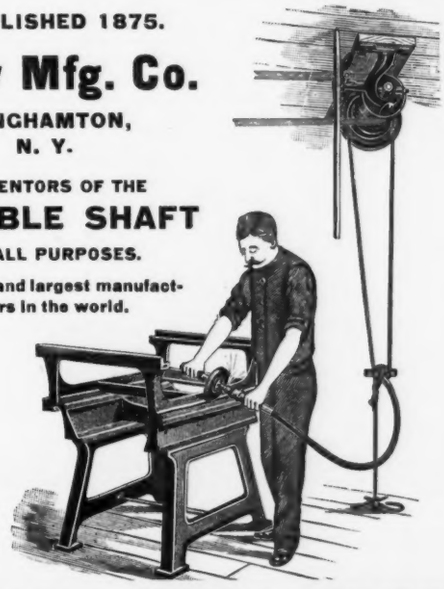
FOR ALL PURPOSES.

The oldest and largest manufacturers in the world.



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Take the Tool to the Work and Save Heavy Handling.

WRITE US FOR CATALOGUE AND PRICES.

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CARBORUNDUM NIAGARA FALLS

If a machine enables a 2-dollar-a-day man to do twice as much work as he could otherwise accomplish, the machine just doubles the value of the man—

In other words, it is actually worth $2 a day more than any other machine that could be employed.

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enable a man to do two and sometimes three times as much work as the same man could do with any other grinding wheel—

That is why we say with such positiveness—

Carborundum not **only** saves money by lasting longer than any other grinding wheels, but
it makes money by doing more work and better work in a day or month.

In order to get best results however it is necessary to have just the right wheel for your work.

Our experts will take pleasure in finding the wheel if you will tell them what the work is.

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Niagara Falls, N. Y.

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Wanted and For Sale advertisements 40 cents a line. Positions and Help Wanted 25 cents a line. Count seven words to the line.

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TOP NOTCH FOUNDRY SUPERINTENDent wanted at once for new machine molding gray iron foundry. The various buildings and equipment just being completed. Strictly up-to-date including continuous pouring. Applicant must be temperate in habits, of good character, aggressive, and above all, a good executive. Full knowledge of molding machines and best application of patterns thereto absolutely necessary. Give full particulars, references, where employed at present, and state salary required. All communications treated confidentially. No cheap man need apply. Address The Cincinnati Milling Machine Co., Cincinnati, O.

SUPERINTENDENT WANTED BY BRASS foundry with present capacity of 150 tons per month, modern machinery and laboratory. Must have experience in rolling mill and blast furnace work, also phosphor bronze and general line of bearing metals. Give experience, with whom, and salary expected. Address Box 704, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED

FIRST CLASS FOREMAN WANTED for modern equipped foundry located in the south, making architectural work. Opportunity given to acquire stock to right party. Address Box 701, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED. MUST be capable of handling a large shop and thoroughly capable of handling all classes of gray iron castings. One experienced in hot water and steam boilers preferred. Address Box 722, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED. MUST be a first-class molder and a hustler. To the right party will pay good salary and sell an interest of $1,000 or more. Do not answer unless you have the money to invest and can make good as a first-class molder. Address Box 727, THE FOUNDRY, Cleveland, O.

UP-TO-DATE FOUNDRY FOREMAN wanted for jobbing foundry. For further particulars address Box 720, THE FOUNDRY, Cleveland, O.

MOLDERS WANTED

FIRST CLASS MOLDER WANTED WHO will take stock in stock company just organizing in Black Hills, old established business. Address J. C. O'Donnell, Deadwood, S. D.

GRAY IRON FOUNDRY MOLDERS wanted. Highest wages paid. St. Louis Car Wheel Company, St. Louis, Mo.

A PRACTICAL MOLDER WANTED OF experience in handling a foundry, one who understands the radiator and boiler business preferred. All communications strictly confidential. Address Box 717, THE FOUNDRY, Cleveland, O.

BRASS MOLDER WANTED, STRICTLY sober man, married preferred, willing to go to small village. Small new foundry, permanent place. Address Molder, Box 207, Elmira, N. Y.

PATTERN MAKER WANTED

PATTERN MAKER WANTED FOR shop in connection with jobbing iron foundry, handling all kinds of work. Good, permanent position for sober, competent mechanic. State age, experience and wages wanted at start. Address Open Shop Foundry, Room 1708, 141 Broadway, New York City.

HELP WANTED, MISCELLANEOUS

FOUNDRYMAN WANTED. ONE WHO has knowledge of malleable work preferred; can find situation in line of promotion if he be a wide-awake man with capacity for seeing things that should be done. If he knows the work it is not essential that he should have had a foreman's experience. This will come if he has energy, methodical habits and desire to produce results. Address Box 716, THE FOUNDRY, Cleveland, O.

A FIRST-CLASS ANNEALER WANTED for malleable iron foundry. State age and qualifications fully. Address Box 700, THE FOUNDRY, Cleveland, O.

SALESMEN. OPENINGS IN OUR twelve offices today for salesmen with experience in or able to sell machinery, electrical apparatus, mill supplies, heating apparatus, fire proofing material, boilers, transmission machinery, paying $1,200 to $5,000. Write today or call on nearest office. Hapgoods, 305 Broadway, New York.

MEN WANTED TO MAKE SIDE MONEY. Liberal commission and prize money for energetic foundrymen in every city and town. SEE PAGE 148.

A COMPETENT MAN WANTED EXPERIenced in cupola practice, to demonstrate and secure orders. Advise references, age and salary expected. Address Box 732, THE FOUNDRY, Cleveland, O.

SUPERINTENDENTS WANT POSITIONS

POSITION AS SUPERINTENDENT OR foreman wanted, in Foundry. Am 44 years of age, have had 20 years' experience in charge of Foundry producing high-grade heavy, medium and light castings with an output of 80 tons per day. Can introduce latest methods in green loam and dry sand. Well up in cupola practice and mixtures of metals. Will furnish references. Address Box 615, THE FOUNDRY, Cleveland, Ohio.

POSITION WANTED AS FOUNDRY SUperintendent by man who is fully competent to take entire charge of foundry, making light or medium weight castings. Address Box 721, THE FOUNDRY, Cleveland, O.

POSITION WANTED, ARCHITECTURAL and ornamental superintendent wishes a change. Experienced in all departments, expert pattern-maker, well posted in modern foundry practice, molding machines, cupola and mixture of metals, brass and bronze finishing shop methods. Can handle large force of men, capable of handling work from start to finish. Can furnish first-class references. Character will bear strictest investigation. Address Box 725, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTENDent or foundry foreman, 18 years' experience in modern foundries. Good on light or heavy, green or dry sand. Best references. Address Box 719, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS MANAGER or superintendent of gray iron works. Practical knowledge of every detail of the business and can handle large plant. Fully competent to construct new works. Address Box 705, THE FOUNDRY, Cleveland, O.

SITUATION WANTED AS SUPERINtendent or assistant by a competent young foundryman with ten years' experience in car wheels and castings. Married and strictly temperate. At present employed, but will be open for engagement Jan. 1, 1908. Best of references from present and past employers. Address Box 709. THE FOUNDRY, Cleveland, O.

FOREMANSHIP WANTED

FOREMANSHIP WANTED OF SMALL jobbing foundry, making castings from 1 pound to 2 tons. Can make any common pattern; handy with tools. Also run lathe or planer to good advantage; 18 years' foundry practice, 7 years as foreman, age 32, married. South preferred, references. Address Box 718, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman by energetic young man, practical molder. At present assistant foreman in foundry employing 50 to 60 molders. First-class references as to character and ability. Address Box 726, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY AN UP-TO-date foundry foreman. Twenty years in the business. Have been with some of the largest gray iron foundries in the United States. Also good experience in malleable and brass. Address Box 723, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman; 20 years' experience in modern foundry practice on light and heavy work, 7 years foreman, best references. Address Box 710, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY EXPERIENCED foundry foreman. Good handler of men, first class molder, well posted on machines. References. Address Box 730, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman in a first-class foundry. One that understands steam boilers and radiator, general jobbing and a first class rigger. Address Box 703, THE FOUNDRY, Cleveland, O.

SITUATION WANTED AS GENERAL foreman in a gray iron foundry, 20 years' experience on all class of work, 36 years of age, married and strictly temperate in his habits, and well fitted to handle a shop doing a wide range of work, loam dry sand, skin dry and green sand work, heavy or light castings, well up on machine molding and the mounting of patterns for same, also cupola practice and iron mixing, strictly an open shop man, and have the ability to design a new shop that will fit the class of work wanted, now open for engagement with references. Address Box 712, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman by a sober, reliable, energetic young married man who is not afraid of work. Address W. A. S., 521 Park Bldg., Pittsburg, Pa.

POSITION WANTED AS IRON FOUNdry foreman in machinery or jobbing shop by experienced foundryman with good executive ability and instructor, 40 years old. New England location preferred. Address Box 733, THE FOUNDRY, Cleveland, O.

PATTERN SHOP HELP

POSITION WANTED AS FOREMAN OF pattern shop. 18 years' experience, 9 years as foreman, 4 years' experience on molding machines. Address Box 724, THE FOUNDRY, Cleveland, O.

POSITIONS WANTED, MISCELLANEOUS

POSITION WANTED BY BRASS MOLDer of 15 years' experience in railroad work. Would like to hear from railroad contemplating starting brass foundry, or those not getting proper results from this department. Very modern in all metals bearing locomotive work, packing, babbitt and anything in this line pertaining to railroad work. Address Box 729, THE FOUNDRY, Cleveland, O.

FOUNDRYMAN DESIRES POSITION, 30; thoroughly familiar with all details of the foundry business including orders, costs and bookkeeping, iron or steel castings. Address Box 715, THE FOUNDRY, Cleveland, O.

SITUATION WANTED. HAVE EIGHT years' experience as office manager and assistant superintendent in stove and furnace foundry. Address Box 728, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY MELTER with 15 years' experience on foundry work, castings, forgings and nickel steel. Able to take charge of foundry, open-hearth department and understands handling men. Address Melter, 521 Park Bldg., Pittsburg, Pa.

POSITION WANTED BY YOUNG MOLDing machine man familiar with mounting patterns in general; am practical and experienced in foundry work. References exchanged as to character, habits, ability, etc. Address Box 731, THE FOUNDRY, Cleveland, O.

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COMPLETE FOUNDRY AND MACHINE shop equipment for sale with a large line of patterns. Original cost, $42,000; will sell for $8,500. A fine local trade of long standing established. Sale must be made at once. Strothman Iron Company, Superior, Wis.

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INVENTORS ATTENTION: MERITOrious patented foundry machinery manufactured on royalty basis. Long experience and unexcelled facilities for reaching foundry trade. Whiting Foundry Equipment Company, Harvey (Chicago Suburb), Ill.

M. ZIPPLER & SONS, CUPOLA EXperts. Patent lining and tuyeres installed in any make cupola with a written guarantee to give entire satisfaction. No charge if not satisfied. For particulars address Francis J. Zippler, 1714 Locust St., Allegheny, Pa.

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BLOWER BARGAINS.

Roots Second-Hand Blowers, bought, sold, or exchanged for new ones. Address,
H. M. PAPWORTH.
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CUPOLAS FOR SALE

TWO SECOND-HAND CUPOLAS IN first-class condition. Shells 72"-82" in diameter and about 40 feet high. Box 800, THE FOUNDRY, Cleveland, O.

CRUSHER FOR SALE

ONE NO. 2 MOUSETTE STEEL CRUSHer for sale cheap. In use four months. Will be sold for best offer f. o. b. Newark, N. J. As good as new. Address D. I. Canfield, 196 Newark St., Newark, N. J.

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TWO NEW A. M. HILL CINDER MILLS for sale for recovering your waste iron or brass from cinders, with or without motor, shafting, belting, etc., to drive same. Complete mills and all new, to be sold at reasonable price. Roessing Bronze Co., Etna, Pa.

MOLDING MACHINES FOR SALE

THREE 24-INCH HINGED TABOR molding machines for sale, also one 36-inch Hinged Tabor Molding Machine. The above are practically new and ready for immediate shipment at very much less rates than factory prices. The Exeter Machine Works, Pittston, Pa.

FOUR ARCADE MOLDING MACHINES for sale at a sacrifice. Acme Steel & Malleable Iron Works, Buffalo, N. Y.

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FLUOR SPAR.—EVERY GRADE. QUOtations delivered anywhere. Cheapest suppliers. Address GEO. G. BLACKWELL SONS & CO., Ltd., Liverpool, Eng., or Agents, Penna. Salt Mfg. Co., Pittsburg, Pa.

FLUOR SPAR—BY THE BARREL, TON or car lots. Address American Fluor Spar Co., Paducah, Ky.

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SECOND-HAND FOUNDRY EQUIPMENT wanted, including Cupolas, Ladles, Tumbling Barrels, etc. Quote price and state condition. Address Box 885, THE FOUNDRY, Cleveland, Ohio.

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A 60-INCH CUPOLA WANTED, ALSO foundry rattles, sand mixer and ladles. Materne Manufacturing Company, St. Louis, Mo.

"LOST!"

This is the despairing cry of the company's president when he picks up the yearly statement and hunts for the margin of profit.

Can *you* be certain at the beginning of the year that wrongly figured costs are not constantly eating into what now seems a good profit—and what will only appear as a *loss* one year from now, too late for remedy?

"Balance Sheet Cost Systems"

forestall all worry and enable you to know every minute just what you are doing and where you stand.

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Edward M. Stradley & Co.

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New Iron Foundry

Located at Huntington, W. Va. Plant consists of main molding shop, 100 x 305 feet; separate machine shop, coreroom, milling room, tar shed, storage shed constructed of concrete blocks, brick piers, steel trusses. Also 25 acres of land located on the Ohio river, with a spur connected with the Chesapeake & Ohio Railroad. Plant is fully equipped with Soil Pipe Fitting Patterns, and is well adapted to general work. Will be sold at sacrifice. For further particulars please write

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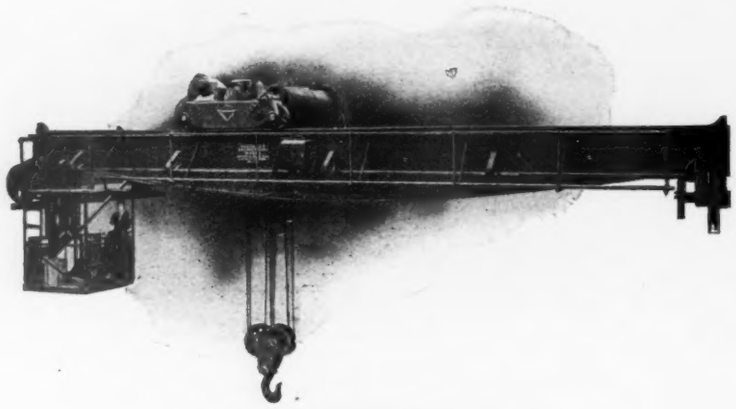

"NORTHERN CRANES"

The above cut shows our 50 ton type E Electric Traveling Crane—a design of special interest to the Foundry trade because of its protected features, its accessibility and strength and its excellent control. "Let us show you" when you want a crane.

NORTHERN ENGINEERING WORKS.
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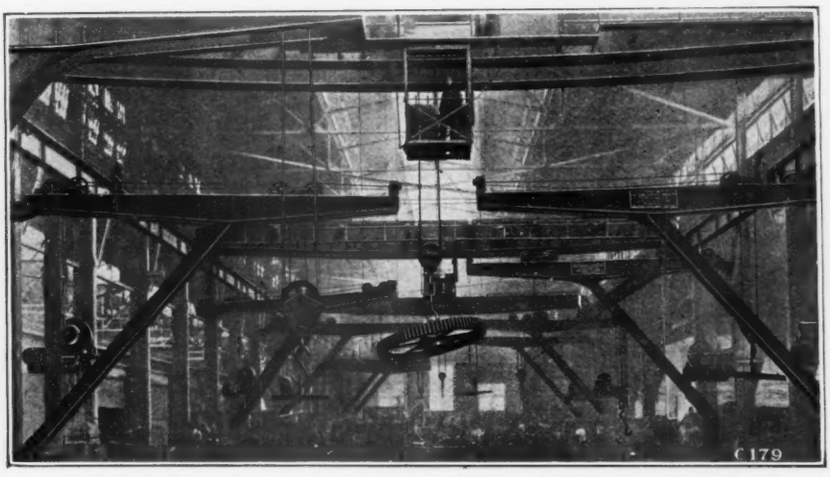

Shaw Cranes

FOR SERVICE

The more exacting the service, the more essential that SHAW CRANES be installed. Thousands of owners of the largest plants in the world have found this to be true. Won't YOU benefit by THEIR experience?

Never Buy a Crane Before Investigating the Shaw

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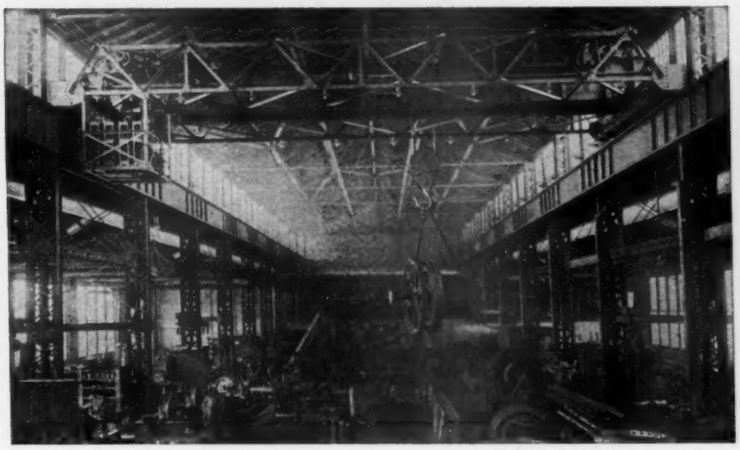


BROWNHOIST

"Brownhoist" Traveling Cranes are Cranes of Quality. If efficiency, low power consumption and durability are first considerations, we are sure we can meet your views.

The Brown Hoisting Machinery Company

CLEVELAND, OHIO, U. S. A.

Branch Offices: New York and Pittsburg.

Engineers, designers and manufacturers of all kinds of hoisting machinery.

NILES CRANES

2 to 200 Tons Capacity.

N.B.P.C.D

NILES HOISTS 3-4 to 6 Tons Capacity.

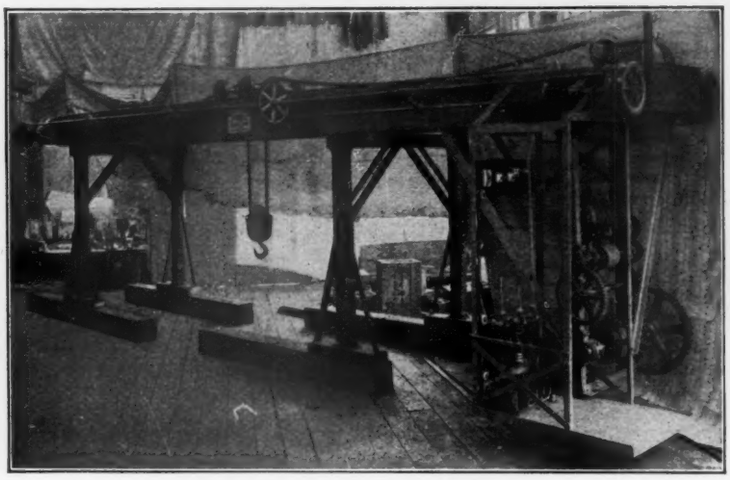
Write for illustrated catalogue "Niles Cranes"

Niles 30 and 40 ton cranes with 5 ton auxiliary hoists, 62 ft. span. National Steel Foundry Co., New Haven, Conn.

NILES-BEMENT-POND COMPANY, 111 Broadway, NEW YORK

Boston: Oliver Bldg. Chicago: Commercial National Bank Bldg. Pittsburg: Frick Bldg. St. Louis: 516 North 3rd St. Philadelphia: 21st and Callowhill Sts. Birmingham, Ala.: Brown-Marx Bldg. London, Eng.: 25 Victoria St. S. W. Agents: The Canadian Fairbanks Co. Ltd., Montreal, Toronto, Winnipeg and Vancouver. Agents for California, Nevada and Arizona: Harron, Rickard & McCone, 436 Market St., San Francisco, Cal., and 164-8 North Los Angeles St., Los Angeles, Cal.. F. W. Horne, 70 C Yokohama, Japan.

Foundry Crane



WHERE the head room is limited and the ladle of hot metal comes close up to the bridge, it is desirable to keep the hoist and motor away from the heat. In addition to the usual automatic electric and mechanical brakes the hoist is provided with a hand brake which gives absolute control of the lifting speed from full speed with a full load, to a few inches a minute for drawing patterns.

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ELECTRIC CRANES

For the new foundry of Seaboard Steel Casting Co.

—Furnished by—

ALFRED BOX & CO

PHILADELPHIA, PA.

Consult us upon your Foundry Crane Problems

We build cranes from 5 to 100 tons

ELECTRIC or HAND POWER

CLEVELAND CRANE & CAR CO.

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50 TON 4 MOTOR STEEL FOUNDRY CRANE

SHEPARD CRANES ARE IMMUNE FROM DIRT.

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Cranes and Hoists

FOR FOUNDRY USE

THE HOIST CO.

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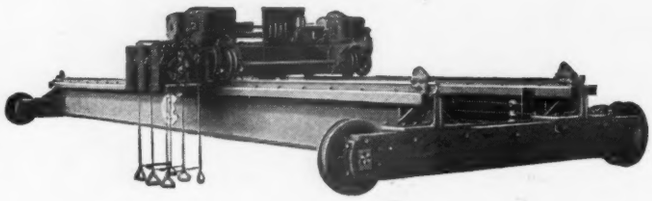

CRANES

A. C. or D. C.
MOTORS.

THE CASE MFG. CO., COLUMBUS, OHIO.

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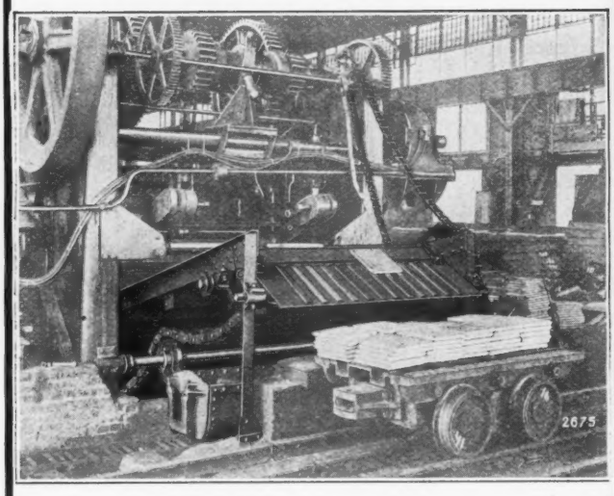

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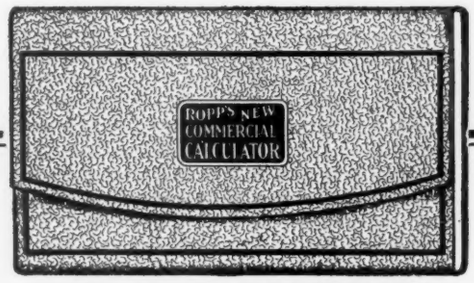

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NORTHERN Electric Hand Pneumatic **CRANES** NEWTON CUPOLAS Trucks Ladles Spring-field **ELEVATORS** Hydraulic Plungers

INDUSTRIAL TRACK SYSTEM OVERHEAD TROLLEYS

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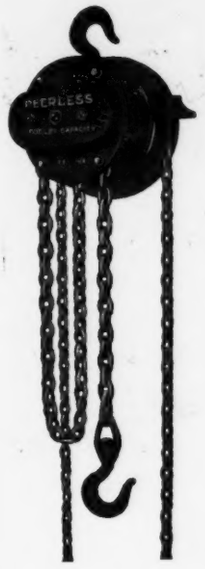
NEW ENGLAND ENGINEERING & EQUIPMENT COMPANY, Weld Building, BOSTON, MASS.

BUILT FOR A LONG BUT FAST LIFE



The Peerless
Hoists

Are
made right
to wear well
on hard usage

Let us
send one on
trial to prove the
high efficiency

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How Is Your Lifting Done?

A 60 TON Crane will lift a small load but at a large proportional cost. No use working a machine representing an outlay of thousands of dollars on a job that a hoist costing hundreds will do.

Then there is the waste of time of the men waiting for the crane.

Yale & Towne Electric Hoists

are admirable for supplementing the work of heavy power cranes. For smaller shops they will do all the lifting. They afford flexible, easily-controlled, and very wearable lifting units, with carefully graded speeds for the most delicate foundry work.

ASK FOR CATALOGS, INCLUDING CHAIN BLOCKS, TROLLEYS, ETC.

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THE SUCCESS OF POURING A PERFECT CASTING

DEPENDS LARGELY UPON THE CONTROLLERS USED ON YOUR CRANE.

DINKEY VENTILATED CONTROLLERS

are the product of ten years of progressive development.

The original type was brought out at the Homestead Steel Works of the Carnegie Steel Co., to meet the special requirements of steel mill service.

The points particularly considered in the original design were: substantial mechanical construction, fitting the controller for the rough handling incident to steel mill work.

Simplicity of operation and compactness, this including mounting the operating resistance within the frame, thus making each controller a self-contained unit.

All parts are of easy access and interchangeable.

Send for Bulletin No. 99 giving details of construction.

The Electric Controller & Supply Co.
Cleveland, Ohio.

The Moyer Tramrail System

¶Now then, Mr. Foundryman,

¶We want you to put your time against ours.

¶We want you to send us a plan of your foundry, drawn to scale, showing the cupola, the girders, the molding floors, the distance from the foundry floor to the underside of the girders; show the position of your core ovens and your rumblers.

¶And tell us whether carrying metal or sand, or cores, or flasks, or all four appeals to you most.

FIG. 5—TRAMRAIL LAYOUT IN FRONT OF THE CUPOLAS

¶Then **we** will make up a detailed working plan of your foundry, showing the "MOYER TRAMRAIL SYSTEM" installed.

¶We will tell you how it can be installed.

¶We will tell you what the **"System"** will cost you f. o. b. your city.

¶We'll tell you just where the "System" will save for you.

¶And how much it will save—and why.

¶It will cost you very little to send such a plan.

¶The quicker the "MOYER TRAMRAIL SYSTEM" begins to work for you, the quicker the savings will pile up. So, better send the plan along today. It's up to you now. We're ready.

FIG. 6—RACKS FOR HANDLING CORES

¶We have just published Bulletin No. 102 showing actual photographs of the Moyer Tramrail System for Foundry use EXCLUSIVELY.

¶The book shows just how pig, coke and scrap can be carried to the CHARGING FLOOR.

¶How the HOT METAL and CORES are carried to the MOLDERS.

¶How the FINISHED CASTINGS go to the rumblers, to the grinders, to the stock bins.

¶"102" shows the CHEAPEST method known of handling both BRASS and IRON, and a lot of other things of interest to the Foundry Trade.

¶We'll be glad to send you a copy of the bulletin if you will write us on your LETTER HEAD, just say—

"Let Bulletin No. 102 come along."

¶We'll know what to do.

MOYER
Tramrail Co.
130 South Third Street
PHILADELPHIA, PA.
U. S. A.

Complete Systems of Overhead Tracking

Made of standard steel I-beam or flat bar steel, with improved safety switches and trolleys, built and installed. Let us submit estimate of cost and other interesting information.

PHILADELPHIA TRAMRAIL CO.

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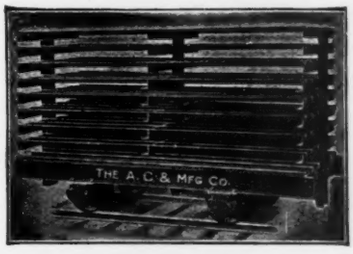
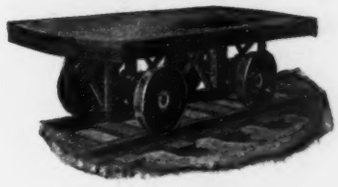
Works: Front and Tusculum Sts.



No. 231-A
Core Oven Car



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General Purpose Car
Made in sizes to order

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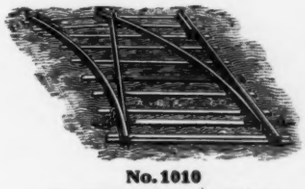

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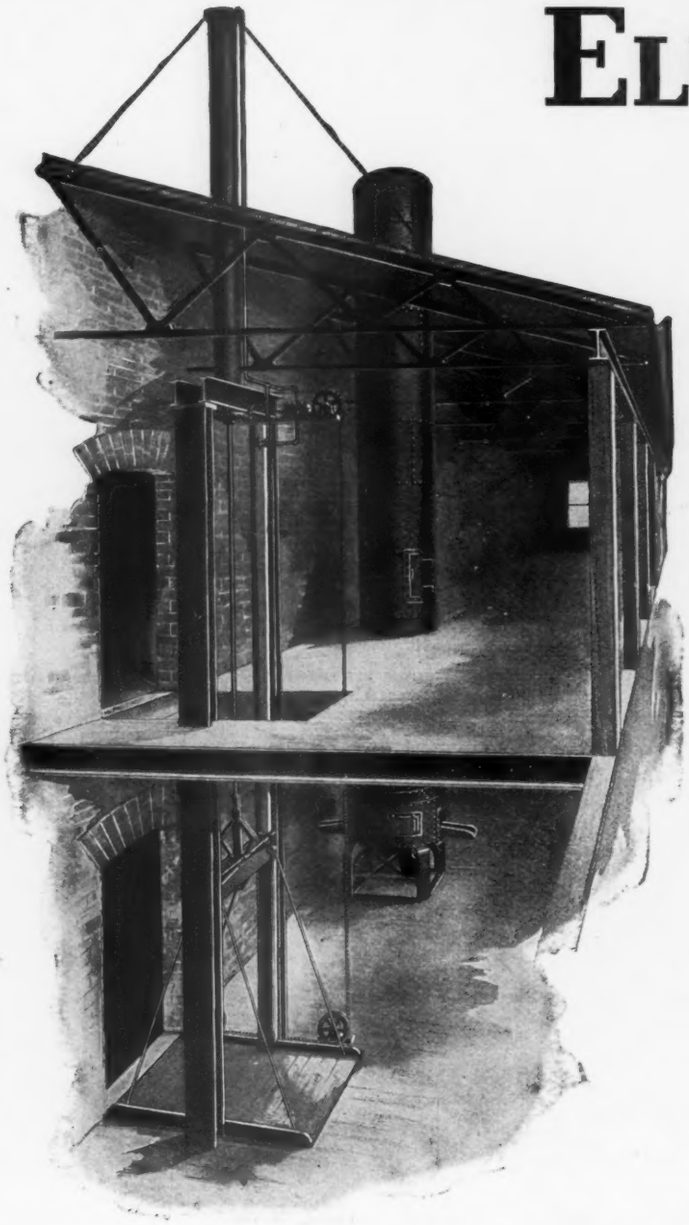

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